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A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

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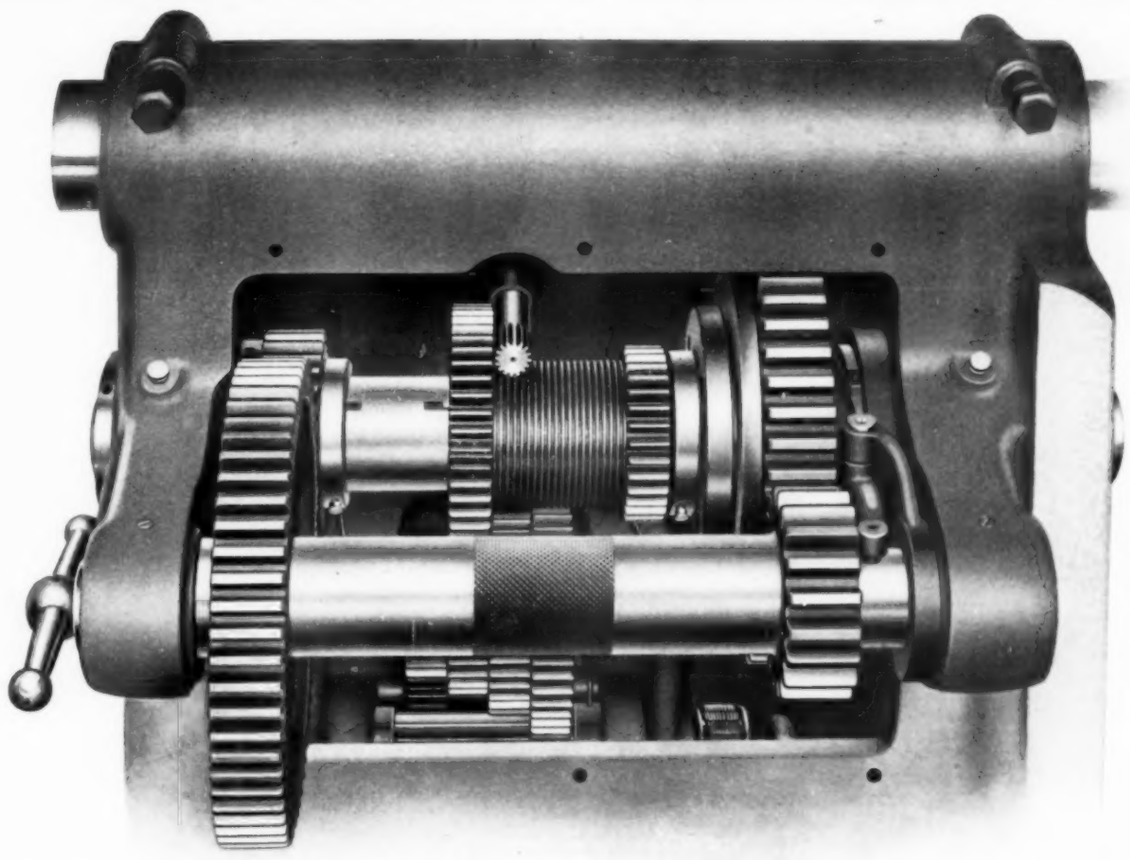

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BROWN & SHARPE MFG. COMPANY

PROVIDENCE, R. I., U. S. A.

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is the modern way ensuring greatest accuracy as well as increased output.

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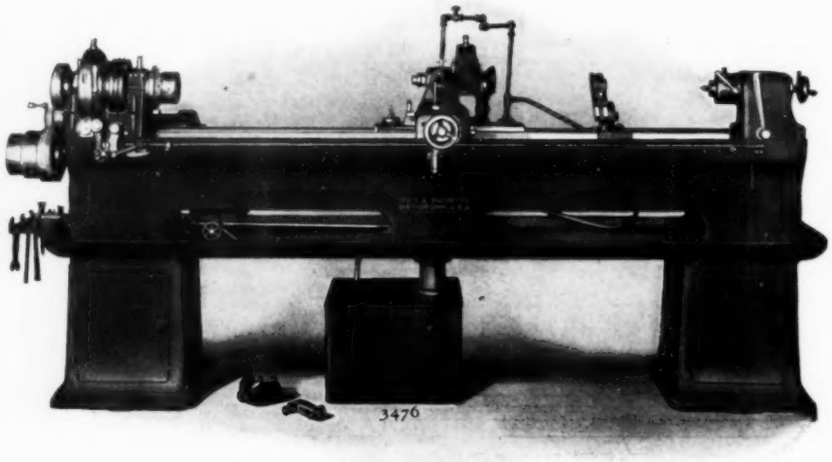

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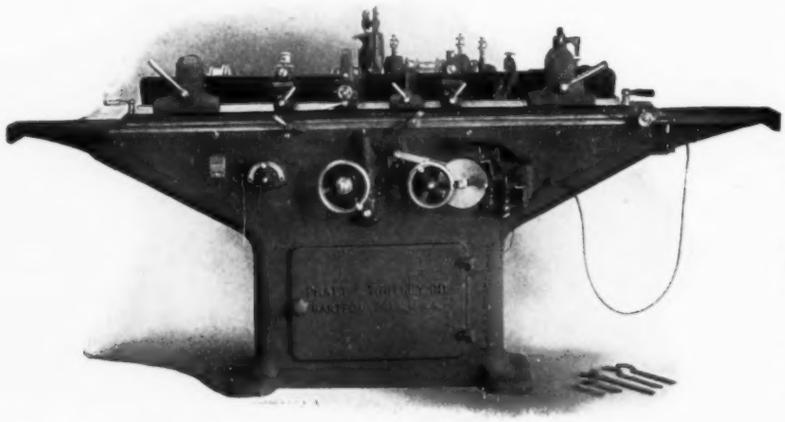

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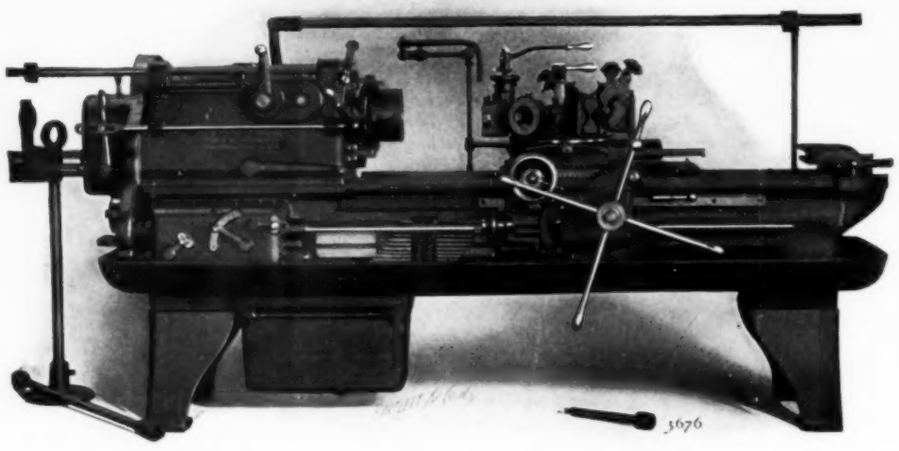

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Something New in Machine-shop Time-keeping

The Data Are Telephoned to the Office and Recorded by Aid of the Calculagraph. The Workman Does Not Leave His Machine

EDITORIAL CORRESPONDENCE

A progressive firm building agricultural machinery has a time-keeping system that is decidedly out of the ordinary, and one that can be truly characterized as "something new in machine-shop time-keeping." Its novelty consists in the combined use of an intercommunicating shop telephone system and several calculagraphs.

In this plant 12 styles of agricultural machines are manufactured. The number of operations on the individual pieces of each machine is about 30; the floor area in use is about three and one-half acres; the diversity of the work is such that some men may work on as many as 20 jobs in a single day. The entire factory force numbers some 650 men. To collect the time-keeping data properly under these conditions 15,000 to 18,000 time cards were used each week. The time spent by individual workmen in going to a time clock and registering his time is a considerable item. This operation necessitates leaving his machine and stopping his work, and where such a large number of men are employed the production thus lost in a week, month or year is an amount not to be ignored.

In this particular plant an inter-communicating telephone system was already in use. This connected all of the various departments through a branch telephone exchange, whose operator was not kept very busy by the ordinary work of operating the board. The superintendent, therefore, conceived the idea of telephoning the time-keeping data to a central time-keeping department. This scheme was first tried out in one department, and worked so well that it was extended throughout the factory. At the present time the entire factory force, numbering some 650 men, are timed in this manner. The half-tone illustration Fig. 1 shows the three operators which are now required, and the desks, racks and calculagraphs in front of which they sit.

FIG. 1. TIME-KEEPERS USING THE TELEPHONE-CALCULAGRAPH EQUIPMENT

A Representative Time Card

Fig. 2 shows a representative time card with the time-keeping data filled in. The date is, of course, known. The order number, employee's number, department, part number, operation and quantity are telephoned to the time-keeping room by the gang boss in charge of the job. The calculagraph records the time when the job was commenced and the time employed after the job is finished. Fig. 2 shows the record as made by the calculagraph; the elapsed time there recorded is 2.8 hours. The job was commenced at about 9:50 a.m.

The calculagraph is, of course, well known, but it may not be out of place to state that the operations in its use consist, first, in inserting the time card in the machine, then operating the right-hand lever if the job is started or the left-hand lever if the job is finished. The record thus made shows the time of starting the job and the elapsed time, or actual working time in hours and tenths of an hour.

The three clerks who operate this system wear head telephone receivers and breast transmitters. They receive all of the messages, operate the calculagraphs, make the proper records on the cards and carry out all of the extensions on the day-work card. All data are called back by the clerks as a check.

Four Kinds of Time Cards Used

A reference to the day-work card requires an explanation that four kinds of cards are used. The one shown by the line engraving, Fig. 2, is styled a piece-work card and is made from a green-colored stock. A similar card known as the day-work card is made from white stock. A third card known as repair card, is in red, and a fourth styled a re-work card is in yellow. To facilitate the handling of these cards with their proper order

numbers, all of the factory orders are classified and have a certain definite range of numbers. For instance; all expense orders are numbered from 1 to 125 inclusive; production orders from 2000 to 50,000; construction orders from 50,000 to 60,000, and shop repair orders from 60,000 to 70,000. Both day work and piece work is carried on; the piece-work operations number about 70 per cent. of the total. A valuable feature of the system lies in the accurate operation data that have been obtained.

Order 41503

Emp's No. 506

Dept. T.

Name Date SEP. 21 1908

Part No. 3504 Oper. 4 Quan. 25

Time 2.8 Rate 024 Cost 50 P. W.

Time Limit Time Gained Premium

Form 216-100M-08

PIECE WORK.

FIG. 2. A SPECIMEN TIME CARD AND ITS RECORD

Origin of the Piece-work Data

As we have stated, the time-keeping data are telephoned to the time-keepers by the gang bosses. Such a gang boss in the act of telephoning is shown by the half-tone illustration, Fig. 3. He holds in his hand a small card which has been made out in the office in duplicate; an example is indicated by the line engraving, Fig. 4. When he receives his section of this card, it bears the part number and order number. As the job proceeds, he adds the workman's number, operation, quantity and exact date and the data which are then upon the card he telephones to the time clerks to be recorded as we have indicated.

The duties of this sub-foreman or gang boss are to inspect and supervise only. Thus he is constantly in touch with each man's work and can always have a job ready for each workman.

Very Few Errors

From these slips, as shown by Fig. 4, it is possible to check the data upon the time cards. The accuracy of the system as carried out is such that during one week but two errors were discovered in handling and recording the data on some 18,000 time cards. The average of such errors is only five. This is a most interesting record when we consider the operations that must be performed. When the sub-foreman starts a workman on a job, he telephones the time-keeper the class of work, the workman's number, operation number and the number of pieces for the job just finished. Cards of the colors and for the classes of work that we have indicated are stacked up in front of the time-keeper. When he receives the message he takes the proper card and writes out the information telephoned and enters the time from the calculagraph. The record for the previous job is closed by the calculagraph and that card is filed in the rack under the man's number.

About 15 minutes before closing time, at night, the cards are made out for the jobs that are carried over to the next day, and the following morning one clerk stamps and sorts the cards in the rack while the other two receive the telephone messages for the new jobs. This method prevents any congestion which might possibly occur if it were necessary to write cards for the entire force at seven o'clock in the morning.

At the end of the day the cards are sent to the pay-roll clerk and the calculagraph records for the elapsed time are entered on a pay-roll sheet. They are then sent to the piece-work clerk who fills in and extends the prices and re-sorts and files the cards by operation numbers. The system is peculiarly adapted to factories which have a great number of operations

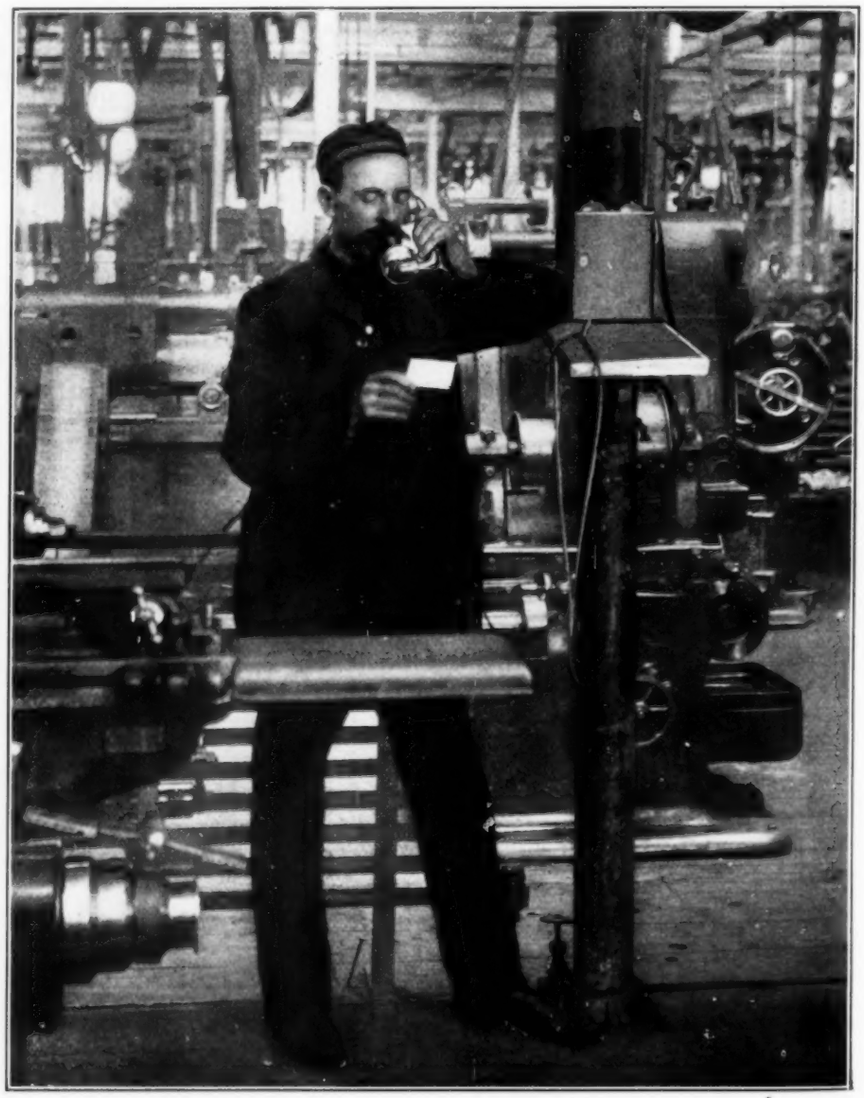


FIG. 3. A GANG-BOSS TELEPHONING TIME DATA TO THE TIME-KEEPER

or a large variety of work, and whose manufacturing processes are spread out over a large amount of floor area. The saving that can be made by so arranging the factory system that the workman stays constantly by his machine, and does not have to leave it for the operation of workman never has occasion to leave his work but is ready to take up a new job immediately after the old one is completed. Any type of telephone can, of course, be used which will establish communication between the factory departments and the cost clerk. The calculagraph, to which we have referred is made by the Calculagraph Company, 9 Maiden Lane, New York City.

Date SEP. 2 / 1908
Part No. 3126 -
Quantity 120
Operation 4
Workman's No. 506
Order No. 41579
Form 122

Date SEP. 2 / 1908
Part No. 3126 -
Quantity
Operation 4
Workman's No. 506
Order No. 41579
Form 122

FIG. 4. SPECIMEN SLIP FROM WHICH GANG-BOSS TELEPHONES TIME-KEEPING DATA

time-keeping, is perhaps greater than at the first thought would be surmised. The cost accountant at the factory where this telephone-calculagraph time-keeping system is in use, has estimated that there has been an increase of production of over 5 per cent. due entirely to this fact, that the

Proportions of Rope Drums without Mathematics

By George E. Barrett

The accompanying curves facilitate the calculation of the amount of rope of known diameter that a drum of given dimensions will hold. The only computation necessary is to determine the ratio between the diameter of the rim and the diameter of the drum.

The curves are plotted from the following formula:

$$A = 0.057\, D^2\, (a^2 - 1)\, \frac{L}{d^2},$$

in which, referring to Fig. 1,

D_1 indicates the diameter of the rim in inches,

D indicates the diameter of the drum in inches,

L indicates the length between the rims in inches,

d indicates the diameter of the rope in inches,

A equals the practical amount of rope, in feet, that the drum will hold, and

a equals the ratio $\frac{D_1}{D}$.

Examples

Several examples will best serve to explain the use of the chart.

(*a*) How many feet of 1-inch diameter

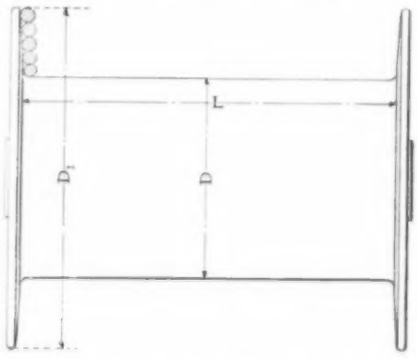


FIG. 1. PROPORTIONS OF ROPE DRUMS

rope will a drum 24 inches in diameter, 40 inches in diameter of rim, and 30 inches long hold?

The ratio

$$a = \frac{40}{24} = 1.66.$$

Enter the scale for a at 1.66 and run horizontally until the $a^2 - 1$ curve is in-

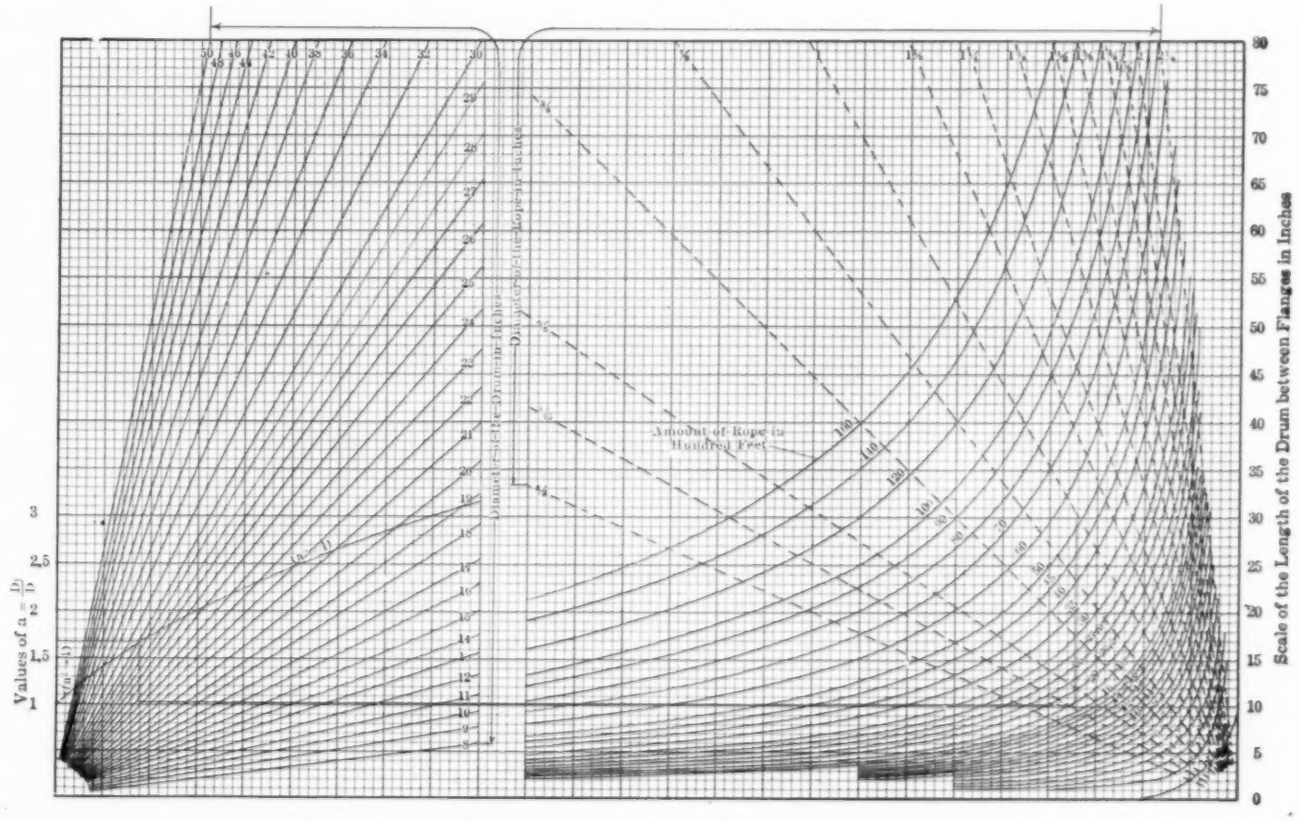

Values of a = D1/D
Diameter of Rope in Inches
Amount of Rope in Hundred Feet
Scale of the Length of the Drum between Flanges in Inches

FIG. 2. PROPORTIONS OF ROPE DRUMS

tersected, then down (or up as conditions require) vertically until the curve for the diameter is intersected, then over horizontally. Enter the scale for the length of the drum at 30 and over horizontally until the curve marked 1 inch for the wire rope is intersected, then downward (or upward as the conditions require) vertically until the horizontal line from the diameter curve is intersected. This point of intersection cuts the curve marked 18. The drum will hold 1800 feet of 1-inch rope. Lines have been drawn on the chart to help the eye to follow this explanation.

(*b*) What should be the length of a drum, between rims, to hold 2250 feet of ⅞-inch diameter wire rope? Diameter of drum is 20 inches; diameter of rim is 35 inches.

The ratio

$$a = \frac{35}{20} = 1.75.$$

Enter the *a*-scale at 1.75, then over horizontally to the $a^2 - 1$ curve, then down vertically to the 20-inch diameter curve; over horizontally to the curve marked 22.5, up vertically to the curve marked ⅞-inch for the diameter of the rope, then over horizontally to the scale for the length which gives 35½ inches, length between rims.

(*c*) What should be the diameter of the rim for a drum 36 inches diameter, 42 inches between flanges, to hold 4000 feet of 1¼-inch diameter rope?

Enter the scale for the length between flanges at 42, over horizontally to the 1¼-inch diameter curve for the diameter of the curve marked 40, for the amount of rope in hundred feet, over horizontally to the diameter curve marked 36 inches, then down vertically to the $a^2 - 1$ curve, and over horizontally to the *a*-scale, which gives 1.71 as the multiplier of the diameter for the rim. The result is 61 inches diameter of rim.

An Universal Vise—System Wolfsensberger

An interesting and valuable small tool or fixture has been developed at the Cologne works of the Gasmotoren-Fabrik Deutz. It is an universal, reversing, work-holding vise.

Fig. 1 illustrates a small size of this system of vises. If the work is too large to be handled by a man, it is placed in position upon the vise and removed by means of a hoist. The hook of the hoist and the sling around a piece of work are shown in Fig. 1. The device was developed to save time in holding, turning and manipulating pieces which have a large number of successive operations.

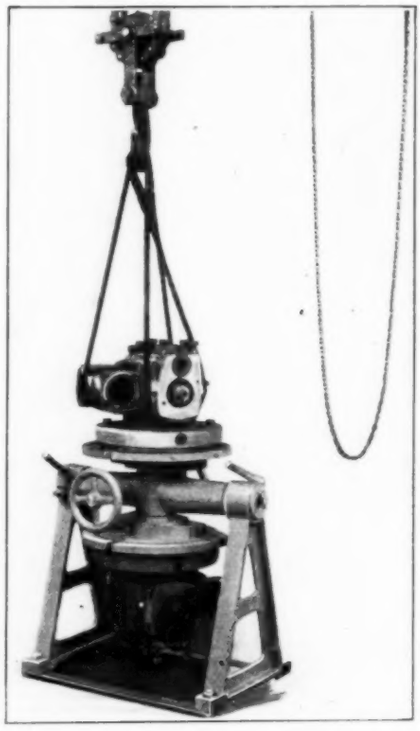


FIG. 1. A SMALL UNIVERSAL VISE WITH WORK IN PLACE

Thus it is used throughout all kinds of machining operations from snagging the castings to the final erecting. It has proved to be of great convenience to workmen in handling and moving heavy pieces. In general a piece is fastened to the vise in only one position. All other positions of the piece are obtained by rotating and swinging the tool or fixture.

Figs. 2, 3 and 4 show details of three different sizes of these universal, reversing vises. Each consists of two symmetrically arranged work-holding plates or tables provided with T-slots or other means of attaching work and carried on a swiveling arm trunnioned in end columns. Ordinarily two pieces are bolted to the vise so that the entire device is in balance and springing and warping are done away with. If a second piece is not at hand for balancing counterweights are used.

Fig. 5 shows an application of these devices to the laying-out table. It is especially convenient on this work for the piece can be swung into any position desired in order to scribe laying-out lines. Its advantage for inclined surfaces will be readily seen. Fig. 6 shows its application for what is ordinarily called bench

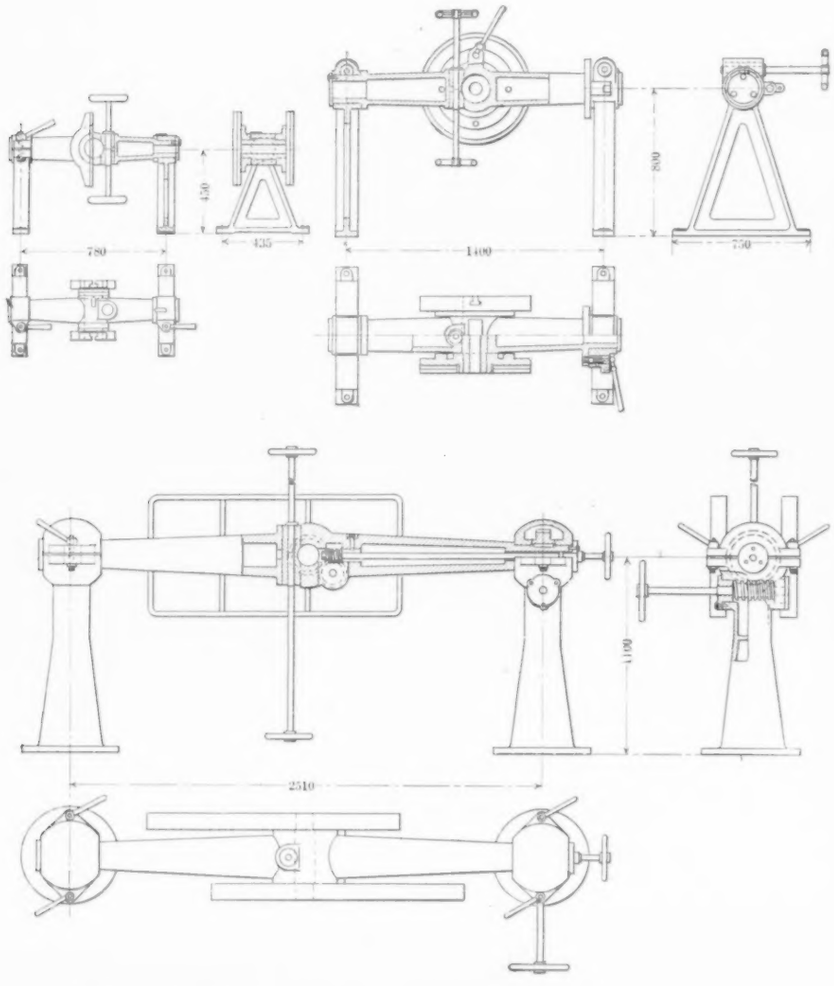


FIG. 4. GENERAL DETAILS OF THREE SIZES OF UNIVERSAL REVERSING VISES

work or vise work. For chipping, filing, finishing, hand-tapping and similar operations it is especially useful.

Fig. 7 shows a battery of various sizes of these vises used in a department devoted to locksmith work. A study of the illustrations will show the large variety of the character of pieces that are being held. Fig. 8 shows a set-up of two 10-horsepower gas-engine frames. From this one set-up on the universal vise all of the holes in both frames are drilled or bored. Fig. 9 shows an application to radial drill work of larger dimensions.

Salient Points for Inventors—Making and Preserving Records

By John D. Morgan*

In some countries a patent for a particular invention is issued to the first person who makes application. In the United States the law says the patent must issue to the first inventor. The exact words are:

"Any person who has invented or discovered any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvement thereof, not known or used by others in this country, before his invention or discovery thereof, and not patented or described in

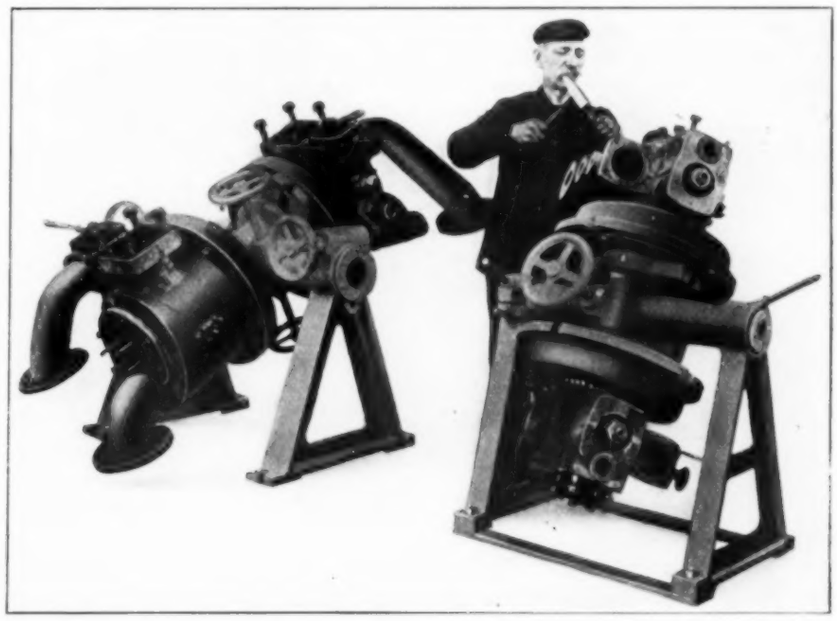


FIG. 6. THE VISES AS USED FOR BENCH OPERATIONS

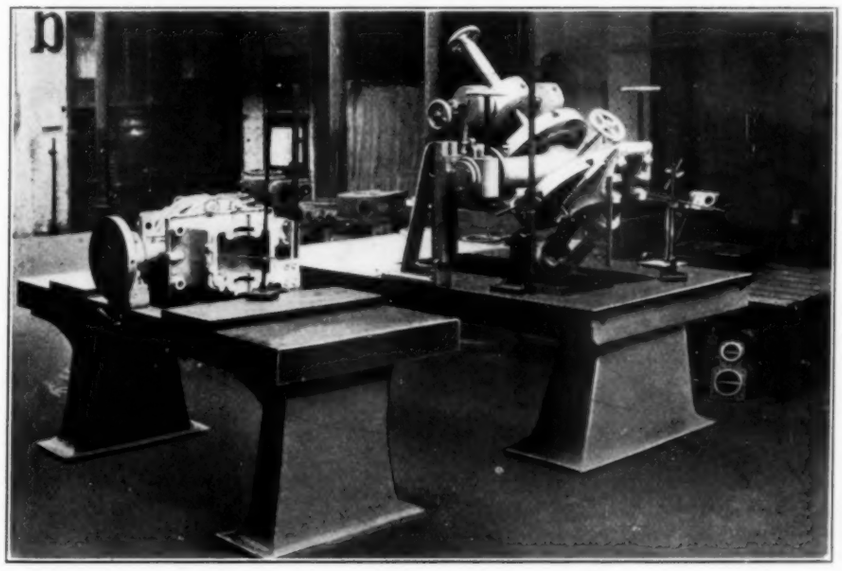


FIG. 5. THE UNIVERSAL VISE ON THE LAYING-OUT TABLE

any printed publication in this or any foreign country, before his invention or discovery thereof * * * may, upon payment of the fees required by law, and other due proceedings had, obtain a patent therefor."

The law requires further that application for patent must be made by the inventor himself, and he must make oath that he believes himself to be the first, and true inventor, he must apply in writing and his signature must be witnessed by two witnesses. In most other countries anyone, individuals or corporations, may apply for a patent on an invention.

This provision of our law which requires that the inventor be brought into direct communication with the Patent Office is very fair and liberal and goes far to protect the inventor against anyone seeking to deprive him of his rights. But in directing that a patent be granted to the first inventor, it practically forbids the grant of a patent to anyone else. A patent issued to someone else by mistake or lack of knowledge by the Patent Office as to who is the first inventor is invalid. A patent may be attacked on this ground at any time during its seventeen years of life. So it will be seen readily how important it is for an inventor to be able to show when he first thought of and when he first began working on his invention, and when he took the other steps to bring it to perfection.

If the invention was "known or used by others in this country, before his invention or discovery thereof, or which had been either patented or published in any country," this would, of course, debar him from receiving a patent where the facts are known to the Patent Office. But if such were the case and the Patent Office knew nothing about it, the facts would render his patent invalid just the same.

It is not at all unusual for more than one inventor to apply for patent upon a given invention at practically the same time. There have been some cases where the number of applicants who have applied for patent on the same invention has been astonishingly large. There are few of the important inventions but have had several claimants for the honor of being the first and true inventor. Only recently I saw a statement in print that Professor Morse did not invent the telegraph although this whole matter was carefully thrashed out in the various courts, including the Supreme Court of the United States, about 60 years ago.

Technical journals nowadays enable men, experienced in the various mechanic arts, to get such a clear and complete survey of the development and also the needs of their art, that many acute minds backed by good practical experience are directed to the question of improvement of machines and processes. Naturally, therefore,

*Member of the New York Patent Bar, formerly United States patent examiner.

it is not unusual for several inventors to work out the same problem about the same time and in about the same way as well.

In view of the fact that it is charged by law with issuing the patent to the first inventor, it becomes the duty of the United States Patent Office in such cases, to find out who is that first inventor. This is done in very much the same way that any other question is tried out by a court. Each applicant has opportunity to take testimony of himself and others and to present any other evidence, and to present his case based thereon before a judge.

Importance of Evidence

It will be seen, therefore, how important it is for a man to have absolute evidence as to when he made his invention for two reasons:

First, in order to get the patent if he is the first inventor and there are several applicants for patent on the invention; and second, to protect his patent against anyone who in an infringement suit might attempt to show that some other one was actually the first inventor, although that other one may never have applied for a patent. For it is true that in case some other one was actually the first inventor the fact that he did not apply for a patent would not make a patent granted to a later inventor valid.

So it will be seen that as long as a patent lasts this question of dates is a very important one. The question of proofs is no less important than the question of dates. It may be a very easy thing for me to know a certain fact in my own mind and yet it may be very difficult for me to prove it to others. It is for the purpose of placing every inventor in a position to easily prove his rights that the following suggestions are made. The old adage "a stitch in time saves nine" is more than true in a matter of this kind. A stitch in time here may save the whole garment.

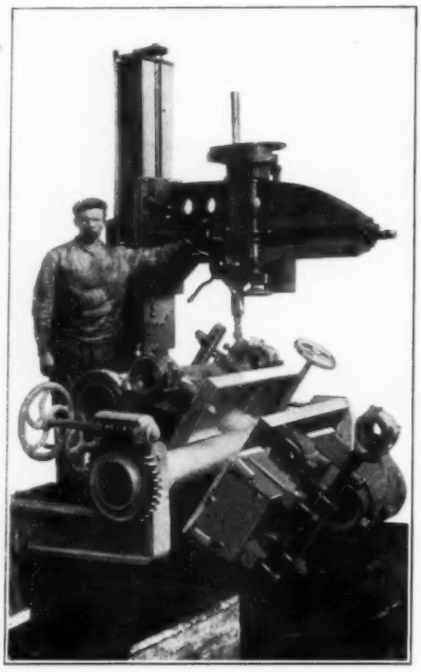


FIG. 8. TWO 10-HORSEPOWER GAS-MOTOR FRAMES SET UP FOR DRILLING

Memory is Unreliable

In the first place, do not trust to mere memory, either of yourself or of others, or to the combined memories of a group of persons, as to any fact. Many a man has been regarded as a liar and sometimes even as a perjurer simply because of the failure or abnormal working of his memory. In fact I am very much perplexed in a certain case at the present time by reason of the different recollections of three persons as to what occurred at an interview some three years ago between them and me. One of the witnesses is absolutely sure, with me, that certain things were said at that meeting and in the presence of all the parties. One of the other witnesses says that he has some recollection that the matter was mentioned but does not recall any extended discussion of it, while the other witness states flatly that he does not recall the matter at all.

Some years ago I was talking with a friend, who was an officer in the Union navy during the Civil War. A special examiner of the Pension Bureau accosted my friend and asked him if he recalled a certain man serving under him as a member of his gun crew, who was injured by an accident to the gun at the Fort Fisher fight. The ex-officer thought carefully for a short time, then said very emphatically that there was no such man in his gun crew, although he recalled the accident to the gun and gave a very detailed account of it to the Pension Bureau official. I was very much interested some time later by my friend's telling me that about

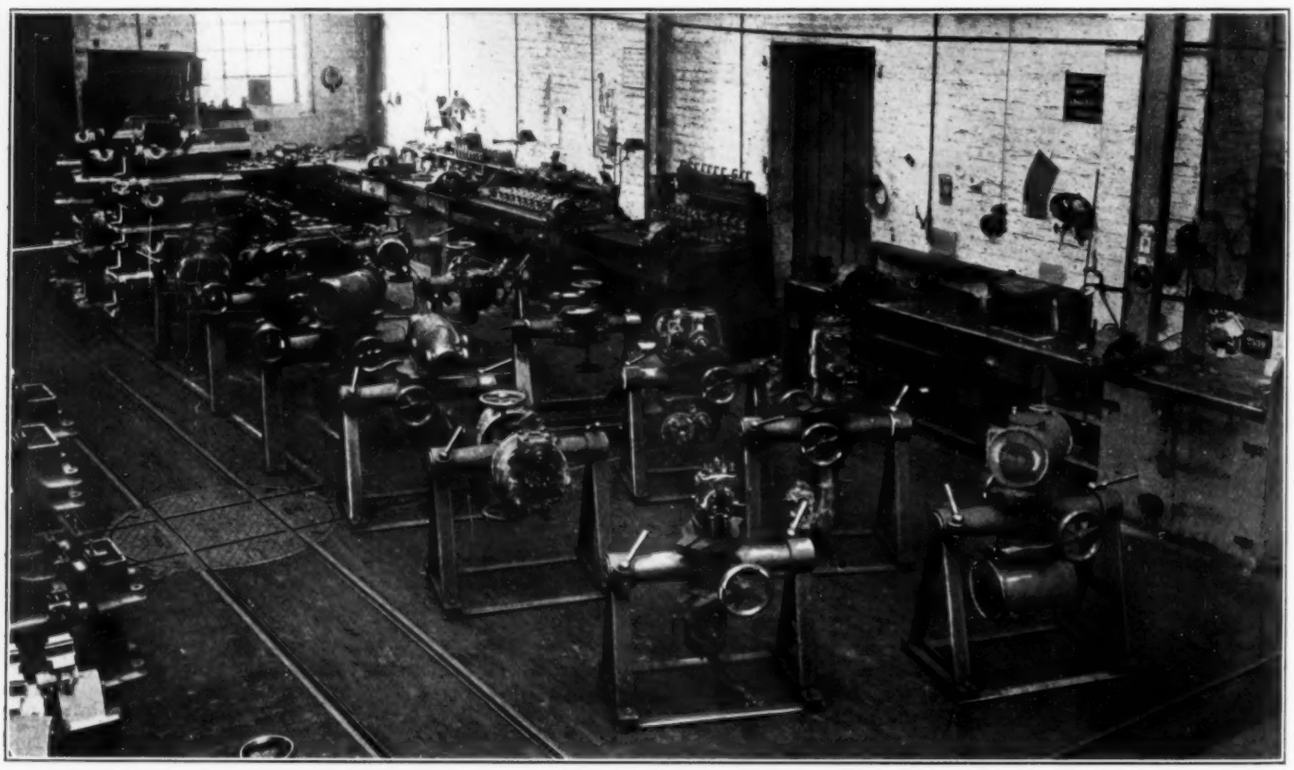


FIG. 7. A GROUP OF UNIVERSAL VISES USED FOR LOCKSMITH WORK

a week after this interview the ex-officer awoke one morning with a very clear and exact recollection of the man in question, could even give a fair personal description of him at that time and also remembered his being sent to the hospital after the battle in question.

Having in mind then the great unreliability of the human memory it is clear that the inventor who wishes to preserve his dates should put his entire reliance upon some other means. Inventions are usually not accomplished in a moment and in most cases they are the fruit of long and careful study. There is first of all a mental vision of the need of a certain improvement or new agency. This is followed then by some general idea of means for carrying it out. The likelihood is that this first idea of means will work, but is not practical, but it is the germ or nucleus from which the final practical invention comes and of which the commercial invention is the logical and full fruitage.

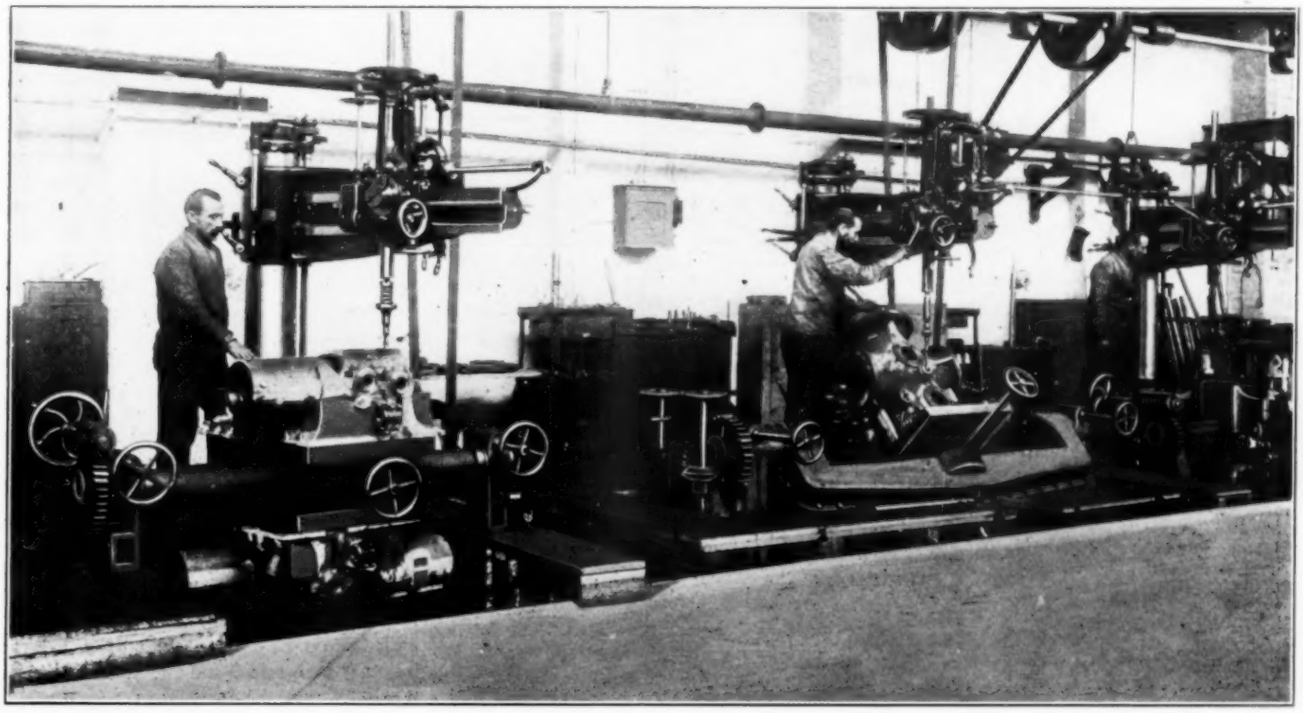


FIG. 9. A GROUP OF RADIAL DRILLS USING UNIVERSAL VISES

Written Records Reliable

Then do not trust to memory, but make written records. Making sketches and writing down a careful and full description is an excellent way of recording progress. Do this with every new idea and then with every development of means and mechanism for carrying it out. Do not refrain from making such a sketch and record of your first ideas and first crude machine or apparatus because you feel sure you can do better later. Making the invention, that is, reducing it to practice, and making a commercial machine are two different things. You are engaged in making a record of when the invention was made and for this purpose the first crude machine may be vastly more important. It may in fact finally determine your title to broad claims for the invention, or even the validity of your patent. So sketches and descriptions should be made of every idea and every apparatus or machine as soon as possible. The use of the camera in preserving records of progress with an invention will be obvious as soon as mentioned.

Be sure to have the data of each sketch, description or photograph established beyond doubt. Date and sign them yourself and have others witness them also by date and signature.

It is just possible that the successive steps in developing an invention occur at points of time somewhat separated from each other. The simplest way of recording and establishing their dates would be to write them down at the time so fully that any person versed in the particular art could understand them, and then have the writing witnessed and dated by other persons. It is advisable also to have as witnesses persons who clearly understand the description of the invention. It is even well to have each witness sign his name together with the date and some remark referring to the written description of the invention, such as, "Foregoing description read by me and his invention explained to me by John Smith this fourteenth day of October, 1908. Thomas Brown." This makes them something more than witnesses of the writing. The writing of their own signatures would serve at any future time to refresh their memories and make of them the best kind of witnesses. This serves also to make the testimony of the different witnesses uniform.

One of the things which goes far to nullify the effect of the true evidence of bona fide witnesses is the variance between the memories of the different persons and the consequent discrepancies in their testimony. This has frequently been such as to greatly weaken and discredit the testimony given.

It is well to make such sketches and write such descriptions as the different steps in the development of the invention are accomplished. It is well also for an inventor in writing such a description to indicate as broad a conception of his invention as possible, although his idea of the scope of his invention will not in itself serve to limit his rights or expand them either.

Another reason for making this detailed, step-by-step record is that the inventor may meet a rival applicant in the Patent Office. In such a case, the question of his diligence may be very material. Without going into the details of that matter at present, the fact that a record was made by the inventor and authenticated by other competent parties, may show that he had the invention continuously in mind and progressed it from time to time as best he could and in such a manner as to save his rights against a more swiftly moving rival inventor.

Inventors have frequently, through the necessity for seeking capital or for some other reason, been obliged to show their inventions to others whom they may have cause to fear will endeavor to secure patent thereon. The preservation of evidence of the different steps taken, as in-

dicated above, would tend to defeat any such attempts if made. Some inventors have requested persons of this kind to also witness the drawings and descriptions and in some cases it has proved an effective safeguard.

The necessity for carefully preserving all records of the progress of an invention will be obvious. The proper place for them is usually a good fireproof safe or a safe-deposit box. The importance and convenience of making and preserving such a record cannot be overestimated, and may exceedingly easily be underestimated unless one has had experience in such matters. It is sometimes astonishing to find how difficult it is to establish a fact or state of facts of which one may be absolutely certain in his own mind. Many an important case has been lost because of this failure to preserve testimony.

RESUME

As a brief resumé let me enumerate the following points:

(a) Make drawings and descriptions of the invention at each step.

(b) See that these drawings and descriptions are thoroughly understood by some other competent persons.

(c) Have the other persons sign the drawings and descriptions, having them also put down the date and some specific reference to the drawings and description.

(d) Preserve these in some place where they will neither be lost nor destroyed.

Any party who is the first inventor, need have but little fear of his invention being stolen by others if he is careful to preserve his evidence in the manner indicated.

An Interesting Sectional Die

BY F. E. ROSS

I recently made an interesting and successful sectional die for a sheet-steel rack after another firm had made three unsuccessful attempts to produce a solid die for the same piece. Of the three unsuccessful attempts, two were to make a solid die for punching the entire number of holes. In each case some of the bridges between the holes cracked in hardening. The third unsuccessful attempt was to make a solid die that would punch every other hole in the piece and then index the piece for the remaining holes. This die was produced without cracking or breaking in hardening, but the work was not satisfactory, because of distortion of the thin bridges by the second punching operation. A knowledge of these three failures caused me to adopt an entirely different method, and the results have been satisfactory.

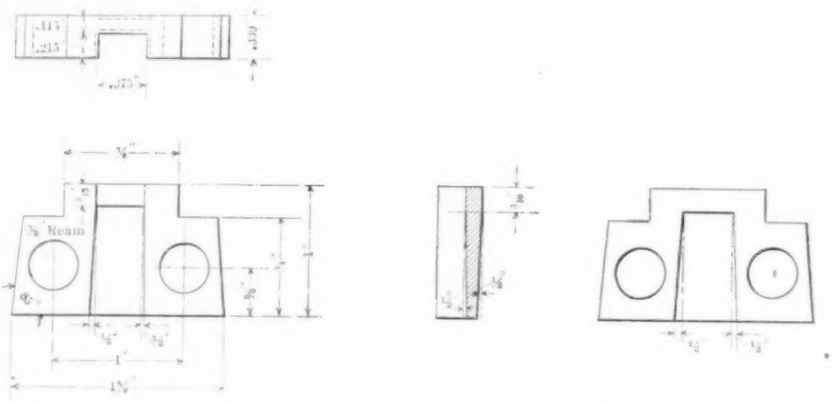


FIG. 2. DETAIL OF ONE OF THE SECTIONS OF THE DIE

FIG. 1. A SECTIONAL DIE DISASSEMBLED

In the half-tone illustration, Fig. 1, the letter *A* indicates a finished piece made with the die. It is made from stock ⅞ inch wide and 1/16 inch thick, and serves as a rack meshing with a pinion. The conditions of the mechanism of which it forms a part are such that great accuracy is required. The finished piece must be exactly 7.590 inches long and contain 22 holes each 0.325 inch long by 0.215 inch wide, and the space between the holes must be exactly 0.115 inch wide.

I decided to build this die of individual pieces, so designed that they should be exact duplicates, and capable of being produced by machine work with very little handwork. A detail of one of these pieces is shown by Fig. 2 and a finished piece is indicated by the letter *B* in the half-tone. From a bar of ½x1⅝-inch annealed tool steel 22 pieces were milled 0.330x1x1⅝ inch and two longer pieces to form the ends. In the 22 pieces a slot was milled 0.215x0.375 inch. Two holes were then drilled through one of these pieces, and this piece was used as a drilling jig to drill the others. The piece to be drilled was located in the drilling jig by means of a square key fitted to the slot which had been milled. Then the various clearances were milled, as shown by the drawing, Fig. 2. After this, the pieces were milled to five-degree angles to fit in the bolster, and a clearance was milled on each of the two upper corners for the set edges.

The pieces were then hardened, drawn and assembled on two ⅜-inch pieces of drill rod. When first assembled, the total length of the die was 0.007 inch longer than the dimensions called for. It was, however, a very easy matter to make this length exactly right by a little lapping.

Meanwhile, a machinery steel bolster had been made, as indicated by *C* in Fig. 1. The assembled sectional die was put into place and wedged by means of a gib and set screws. Four large screws were provided to care for the end thrust upon the die if any took place. These are plainly shown in the half-tone. The set edges are indicated by *D* and the stripper by *E*. Their application is so plain as to need no special description.

The Punch

The punch indicated by the letter *F* was made in the following manner. The punch holder was first planed up to dimensions, and the shank inserted. It was then clamped against the face of the finished die and a small drill jig which exactly fitted the rectangular holes in the die was slipped in from the back side, and through this jig the 22 holes in the punch holder were accurately drilled. Thus the exact spacing of the die was transferred to the punch holder. Meanwhile 22 punch blanks had been turned up, and were now secured in the holes in the punch holder. The holder was then set up in the milling machine and the punches straddle-milled lengthwise to exact dimensions. A roughing cut was then taken through the space between each pair of adjacent punches of such size that each punch was a few thousandths large. A finishing cut was then taken over one side of each punch, accurate measurement being taken from each punch to its neighbor in order to insure that these successive spaces were spaced exactly right. The punches were then removed from the punch holder and the remaining face was finished to micrometer measurements. After hardening, the punches were replaced in the holder, carefully squared, and it was found that only two of the entire 22 had sprung or warped. After these two were straightened, the punches entered the die perfectly. It will be noticed that the punches are held in place by set screws.

On one end of the punch a shear blade was attached to cut off the finished strip after the holes had been pierced.

Some 6000 pieces were made at the first setting of this punch and die, with complete success. To briefly summarize some of its good points: The parts are all made by machine work, exact measurements can be taken with the greatest of ease; if one of the sectional pieces breaks in hardening it can be easily replaced; if one of the pieces breaks with use it can be easily replaced; and for a given degree of accuracy it is much cheaper to make than a corresponding solid die.

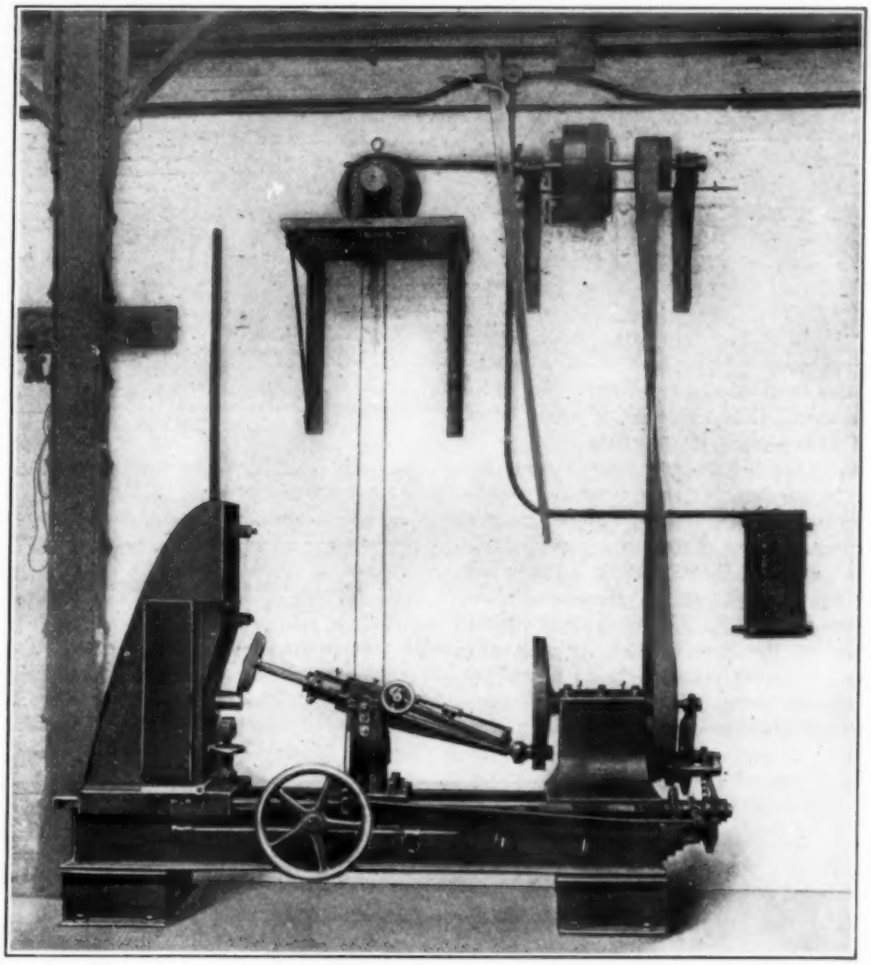
Grinder for Switch Point Pins

Grinding a pin at the end of an eight-foot switch point is not an easy job because it is difficult to find any machine or method of swinging a piece of this size. So a machine was built in which the switch point remains stationary and the wheel travels around the pin. These pins are cast solid with the switch point, and as they are of manganese steel, nothing but grinding will answer for this work.

The machine has sort of a lathe bed with a fixed head at the right driving a face-plate carrying a crank pin with a ball socket. In the center of the bed is a stand which carries a swiveling yoke, and in this is carried the grinder frame, mounted on trunnions. The turning of the face-plate gives a rotary motion to the back end of the grinder frame which swings in the yoke and transmits the rotary motion to the grinding wheel at the other end.

The switch pin is centered in the machine by means of the V-block shown under it and, after being fastened, is swung back out of the way by the lever in front, so as to give a full path for the wheel to travel in. The diameter of the pin is regulated by running the wheel in and out of the grinding frame by means of the small hand wheel which controls the end movement of the grinding spindle through the bevel gears and screw shown.

The work is fed under the wheel by moving the left-hand head through the chain gearing at the right, which drives a screw inside the bed. Hand movement can also be had through the large hand wheel shown in front, while the direction of the power feed is controlled by the lever directly behind the large wheel, which throws the clutch into either the forward or backward motion. Automatic stops are also provided by tripping the lower end of the clutch lever through stops on the rod shown in front of the bed.



NOVEL GRINDER FOR SWITCH POINT PINS

The grinding frame is driven from a slow-speed countershaft, as shown, while the wheel itself belts direct to a motor overhead which drives through bevel gears in line with the center of the trunnion.

This is in service at the Schuylkill avenue shops of the Philadelphia Rapid Transit Company, and we are indebted to H. H. Nichols, the master mechanic, for the photograph of the machine which was designed by his son.

Press Tools Used in Typewriter Manufacture

Sectional Dies Are Employed for Piercing and Blanking Various Pieces and Adjustable Tools Are Used for Different Lengths of Key Stems

EDITORIAL CORRESPONDENCE

The accompanying engravings illustrate a number of interesting press tools used in the manufacture of typewriter parts at the works of the Royal Typewriter Company, Hartford, Conn.

Figs. 1 and 2 represent a large, built-up punch and die for piercing the steel plate shown at the front of the die. This piece is known as the "anchor" plate, and through the slots which are punched in it pass the lower ends of the key stems. The notch at the side of each slot in the anchor plate allows a retaining pin projecting from the side of the key stem to pass through in assembling, this pin then acting as a stop to limit the upward movement of the key when it is depressed and released in the operation of the typewriter. The grouping of the openings in the anchor plate thus corresponds to the arrangement of the keys as they appear at the front of the typewriter. In addition to the slots a number of round holes are also pierced in the plate.

In the half-tone and line drawing referred to the construction of the punch and die is shown clearly. Both members are quite heavy, weighing together about 500 pounds. The die block is provided with four guide posts or pilots which are close sliding fits in the corresponding holes in the punch block, so that the latter is properly guided in its operation.

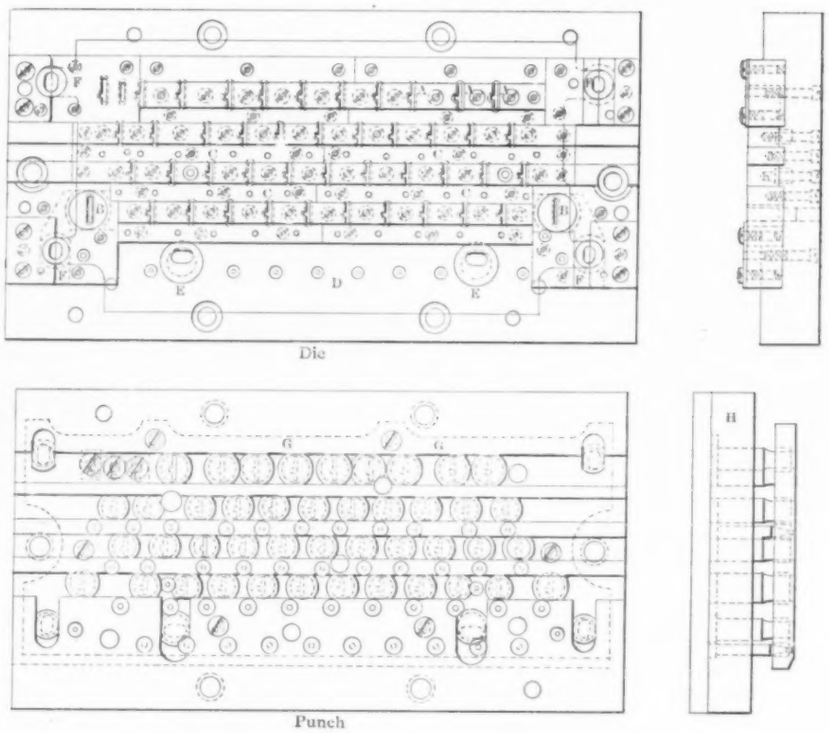


FIG. 2. CONSTRUCTION OF SECTIONAL TOOLS FOR PIERCING ANCHOR PLATES

The die openings for the regular openings or slots in the anchor plates are, with two or three exceptions, formed between blocks *A A A* attached to the die body, as shown in Fig. 2 by fillister-head screws and locating bushings through which the screws pass. The die members for the slots at the extreme ends of the front rows are of circular form seated as indicated at *B B* and hence as readily

FIG. 1. SECTIONAL TOOLS FOR PIERCING ANCHOR PLATES

replaced as the rectangular blocks *A A*. The piercing dies for the small round holes are placed in the strips *C C C*, which are placed end-to-end and form spacing members between the different rows of die blocks *A A*. The dies for the first row of round perforations in the anchor plate, as shown at *D* are inserted independently in the die block as are also the two dies *E E* and the four dies *F F* for the round-end oblong holes near the front and in the lugs at the ends of the plate.

In Fig. 1 the stripper plate, or pressure pad, is drawn back sufficiently over the ends of the punches to show the shape of these punches. Those for the rectangular openings are formed, as at *G*, in Fig. 2, with round bodies flatted at opposite sides to locate them square and are seated firmly in the plate *H*, which is secured by screws and dowels to the punch block.

Punch and Die for Type-bar-spring Plate

The sheet-steel pieces shown in the foreground of Fig. 3 are blanks, which are bent in another operation and known as type-bar-spring plates. One of these is attached to the under side of each typewriter frame for holding the ends of the springs which return the type bars after the keys are struck by the operator. The dies shown are "five-stage," that is, the sheet metal as fed in from the side is operated upon in five strokes before the finished blank drops out. The small perforations in the work are in three rows. At the first stroke of the press every other hole in the two outside rows is perforated by punches *A* and the oblong hole at the center of the plate is formed by punch *B*. The stock is then fed forward and the second group of punches at *C* perforates the intermediate holes in the two outside rows. At the next stroke the single row of punches at *D* perforates every other hole in the middle row in the work and at the fourth stroke punches *E* produce the intermediate holes in the middle row not perforated by the punches *D*. At the fifth stroke the blank is cut out by punch *F*. Each stroke thereafter produces a finished blank. The arrangement of punches in groups offset from one another allows the punches to be made with bodies of ample size and allows the dies to be made in the form of independent bushings which are pressed into the die body proper. These die openings are not brought out very distinctly in the half-tone, but their positions are indicated by the small holes in the stripper at the right-hand side of the group. As the blanking die is separate from the plate containing the perforating dies the latter plate does not need to be hardened, as each die is hardened independently before seating in place. The view of the punch in Fig. 3 shows the four pilot posts at the corners, which enter corresponding holes in the die block and the springs which back up the stripper are also plainly visible on their retaining screws around the edges of the punch.

Another Set of Piercing and Blanking Tools

The press tools in Fig. 4 are for making typewriter-carriage end blanks, two of which are shown directly in front of the punch. This set of tools is illustrated as representing an interesting example of a combination of piercing tools of various sizes and forms, with a blanking punch and die. The punch and die plates in this case are piloted by two posts at opposite corners. The piercing punches all have round shanks which are inserted in the main plate or punch block, and the die plate is bushed with separate dies to match each punch. The half of the die plate for the piercing operation is, therefore, left soft, the end in which the blanking die is formed being hardened as usual. As the stock is fed forward after

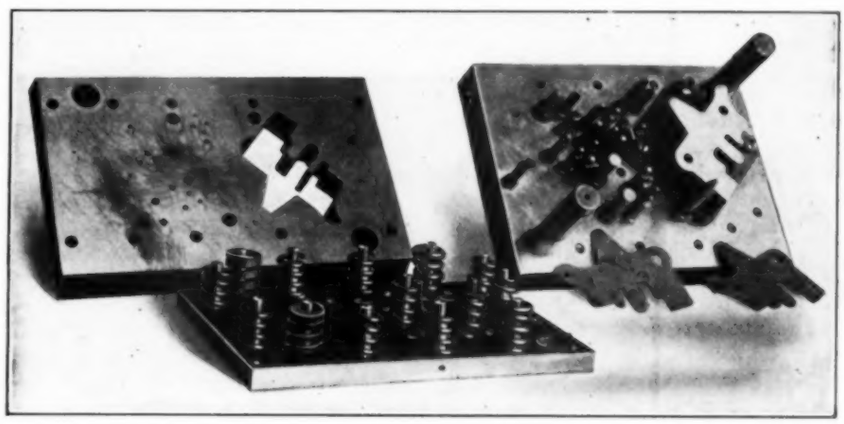


FIG. 4. PIERCING AND BLANKING TOOLS

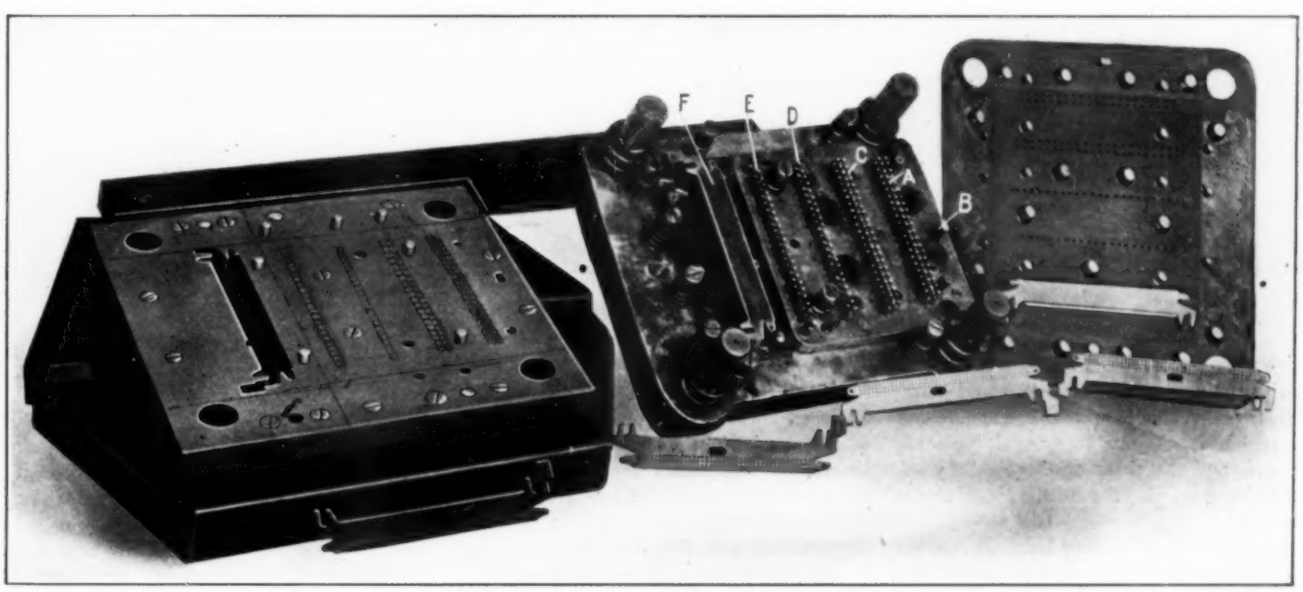


FIG. 3. PRESS TOOLS FOR FIVE OPERATIONS

the piercing operation, two of the holes pierced are engaged by pilot pins shown at the left of the blanking punch and the material is thus located correctly and held while the piece is blanked out at the second stroke of the press. At each stroke following a completed piece drops out of the dies.

Adjustable Die for Cutting Different Lengths

The die in Fig. 5 is for piercing and cutting off key stems of which twelve different lengths are required for the typewriter. Several of the stems pierced and cut to length will be noticed in front of the die. The end of the piece, as shown about full size at *a*, Fig. 6, is reduced in width in the cutting-off operation in order to provide a seat to receive the key which is pressed onto this reduced portion of the stem. The narrow stock is fed through guide *A*, Fig. 5, over piercing dies *B* and shearing die *C*, which is fitted into adjustable slide *D*. The first stroke of the press ram cuts the end of the first piece to the shape *a*, Fig. 6, and punches the three holes at the other end. The stock is then fed forward to adjustable stop gage *E* and the second stroke of the press cuts off the first stem, leaving it with a round end like *b*, Fig. 6, forming the narrow end *a* of the next stem and piercing the three holes in the end of that piece. It is obvious that by shifting the gage *E* and the shearing die *C*, the work may be cut to the different lengths required.

The position of sliding block *D* and die *C* is varied by withdrawing pin *F* and moving the block endwise to the new location desired. The twelve holes for the locking pin are placed at an angle to the edge of the die, and there are twelve holes similarly located in the bolster in which the die slides. This staggered arrangement is adopted to enable the die to be adjusted the small amount necessary to accommodate the series of stems, which in some cases vary only slightly in length from each other. Each hole in the sliding die block *D*, having a corresponding hole in the bolster underneath, the locking pin *F* when in any given hole in *D* cannot possibly engage with the wrong locating hole below. Both sets of holes are located and bored accurately and fitted with lapped bushings.

The stop gage *E* against which the ends of the stems are fed before cutting off is provided with a similar adjustment and a locking pin *G*. When die *C* is adjusted to a given length of stem (which means that its position is changed relatively to the fixed piercing die *B*) the stop gage *E* must be set to correspond. The holes in the gage *E* and the holes in its guide for pin *G* are plainly shown and illustrate clearly the oblique arrangement of the two series of index holes. The lengths of key stems produced with the different settings of the die are stamped opposite the respective indexing holes so that the two pins *F* and *G* may be located in the correct holes by simply glancing at the figures stamped beside them.

F. A. S.

FIG. 6. KEYSTEMS AS CUT OFF ON THE PUNCH PRESS

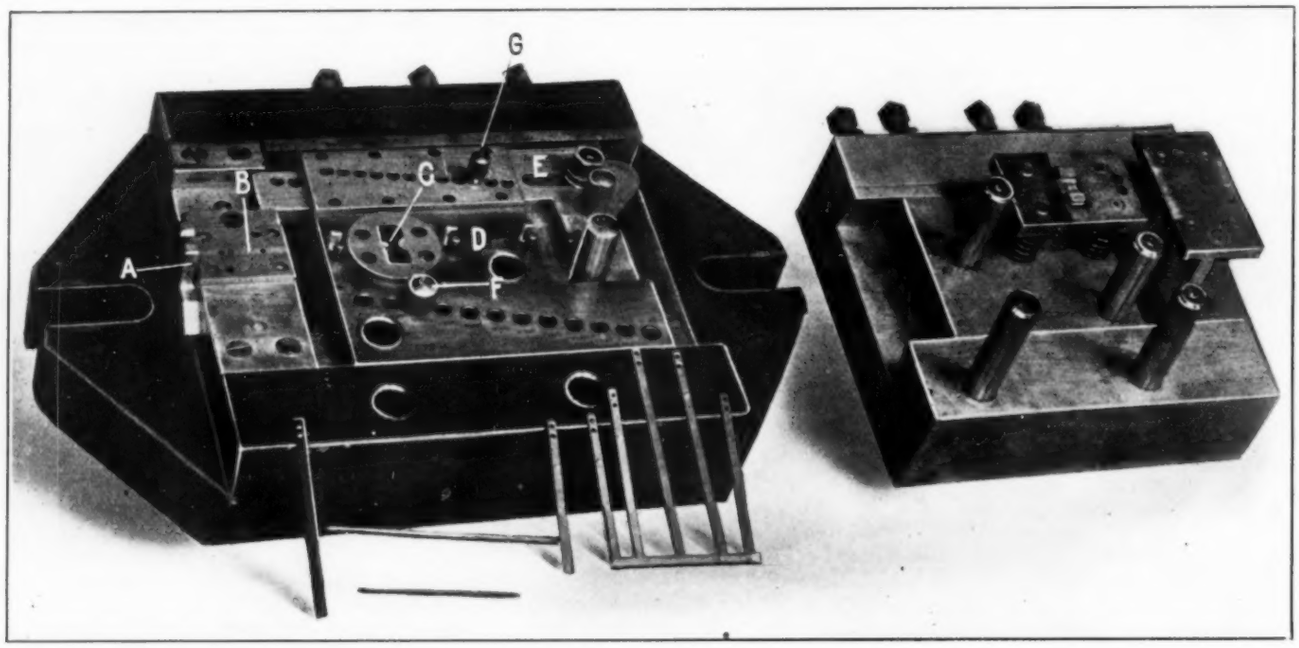


FIG. 5. AN ADJUSTABLE DIE FOR DIFFERENT LENGTHS OF WORK

An Eighteen-Speed Gear Box

By C. A. Legge

The accompanying line engraving shows an eighteen-speed, constant-speed drive, gear box, which I recently designed for a drilling machine. It is not claimed that the arrangement possesses any very new points; the idea was to make a gear box that, (1) could be put onto the machine in place of the regular cone and back gears with as little alteration of patterns as possible, (2) that could be operated with few handles, (3) that would be as durable as possible and (4) that could be manufactured cheaply.

There are no friction clutches whatever, and though it is necessary to stop the machine, or at any rate slow down, to change the speed, this is not such a serious evil after all. The belt-shipping handle is in a very convenient position and may be moved easily; the speed of the belt (about 1200 feet per minute) is great enough to allow an easy and quick movement.

All the gears are of steel; those that revolve loosely on their shafts are bushed with gun metal. One important feature is the small number of gears that is required; it will be seen that there are only 11 gears to give 18 speeds. In contrast with this I have seen an arrangement where 14 gears are used to get 12 speeds

one-half of the gears running loose on their shafts at all times.

Referring to the engraving, the driving belt runs on the tight and loose pulleys *a* and *b*, Fig. 5; the loose pulley runs on the stationary bushing *c*. On the shaft *d*, to which pulley *a* is keyed, is mounted the sliding tumbler bracket *e*, Fig. 6, which carries the three gears *f*, *g* and *h*; *g* and *h* will mesh at will with either *j*, *k* or *l*, Fig. 5. These latter gears are solid, that is, all in one piece and revolve loosely on the variable speed or main shaft *m*; which the gears are brought into mesh by returning *C* to position 7.

The collar *M* is a simple provision for insuring a correct location of the sliding gears *s* and *t*; because the handle *D* must be either to the extreme right or left before the gears can be put into mesh by the eccentric shaft handle *C*.

On the boss, at the right-hand end of the cone gears *j*, *k*, *l*, is the clutch *u* which engages (by means of the lever *A*) with another clutch cut on the turned boss of the handle *C*. When this handle be put into mesh when either one or the other, whichever is required, is exactly opposite to its mating gear.

The lower part of the box carries sufficient oil for the larger gears, and also the gear *f*, to dip in. Centrifugal force is then depended upon to carry the oil to all the other gears and also to lubricate the shafts *r* and *m*, which carry the loosely revolving gears.

The table, Fig. 1, gives the spindle speeds, lever positions, etc., and shows that the speeds are very nearly in geo-

Spindle Speeds	Position of Lever:-			Size of Hole at a Cutting Speed of:-		
	B	C	D	20 Ft.	30 Ft.	40 Ft.
250	1	8		5/16"	7/16"	9/16"
208	2	8		5/16"	7/16"	9/16"
178	3	8		7/16"	9/16"	11/16"
149	4	8		9/16"	13/16"	1 1/16"
128	5	8		11/16"	1"	1 5/16"
107	6	8		13/16"	1 3/16"	1 5/8"
92	1	7	9	1"	1 7/16"	1 15/16"
76	2	7	9	1 3/16"	1 11/16"	2 1/4"
65	3	7	9	1 3/8"	1 15/16"	2 5/8"
54.5	4	7	9	1 5/8"	2 5/16"	3 1/8"
46.8	5	7	9	1 7/8"	2 11/16"	3 5/8"
39.2	6	7	9	2 1/8"	3"	4 1/8"
33.5	1	7	10	2 3/8"	3 3/8"	4 5/8"
27.8	2	7	10	2 7/8"	4 1/8"	5 5/8"
23.8	3	7	10	3 3/8"	4 3/4"	6 5/8"
20	4	7	10	3 7/8"	5 3/4"	7 3/4"
17.2	5	7	10	4 5/8"	6 3/4"	9"
14.4	6	7	10	5 3/8"	8"	10 1/2"

Table showing Position of Levers, Spindle Speeds and Size of Hole for each Speed.
FIG. 1

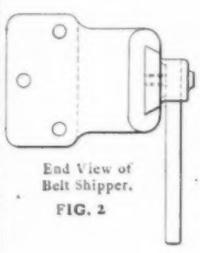
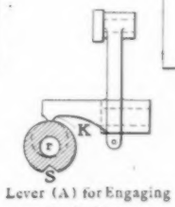


FIG. 2



Lever (A) for Engaging Single Gear.
FIG. 3

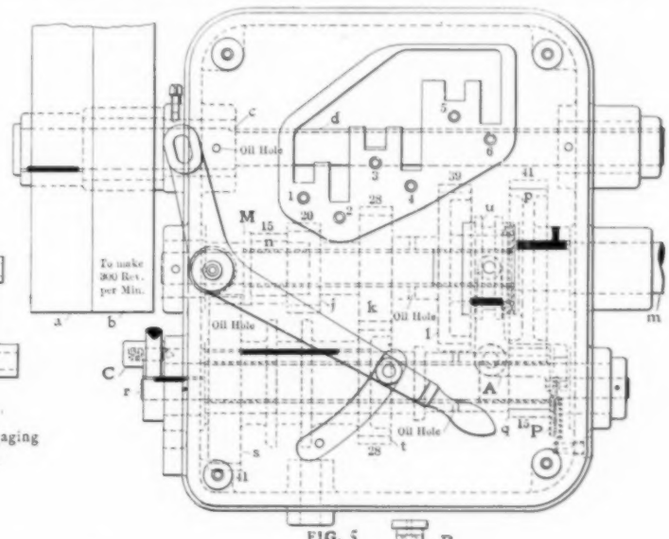


FIG. 5

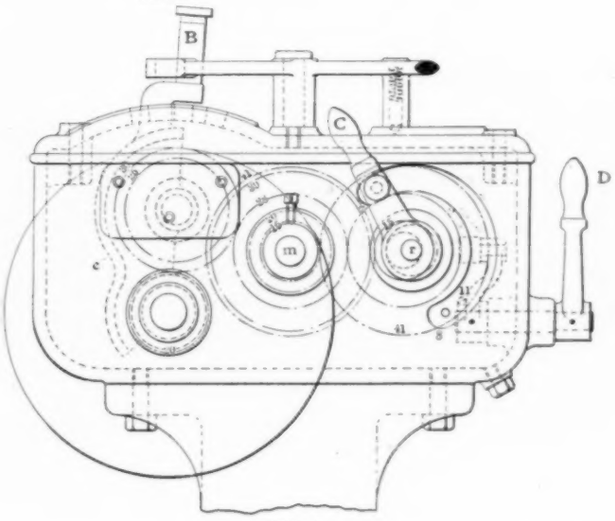


FIG. 4

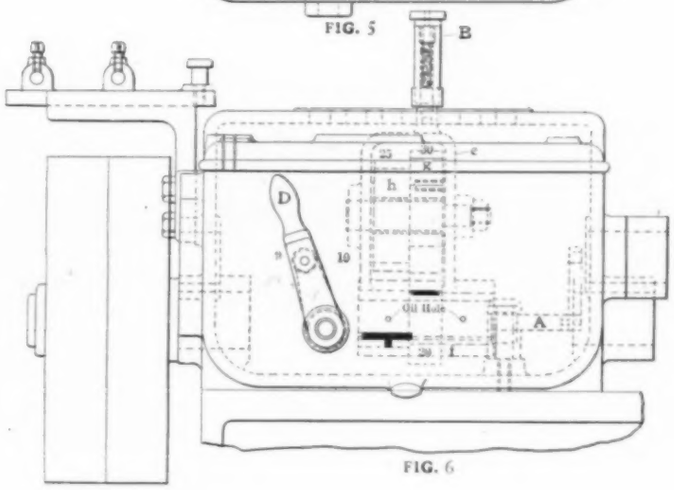


FIG. 6

AN EIGHTEEN-SPEED GEAR BOX FOR A RADIAL DRILL

fixed to this cone of gears and revolving with it is the pinion *u*.

By manipulation of the handle *B*, Figs. 4 and 6, six speeds are obtained, which, with the addition of the two sets of back-gear speeds, are increased to eighteen. The gear *p*, Fig. 5, is keyed to the shaft *m* and is driven by the quill pinion *q*, which revolves on the eccentric shaft *r*; sliding on the quill are the gears *s* and *t*, which are worked by the handle *D*.

In the position shown the single back gear is in use. To engage the double back gears the handle *C*, Fig. 4, must be swung back to position 11 and the handle *D*, Fig. 6, moved to 10, after moves around to 8 the notch *S*, Fig. 3, comes opposite the projection *K*, this allows the spring *P*, Fig. 5, pulling at the lever *A* to bring the clutch *u* into mesh with the clutch in the gear *p*; the machine is then running without the back gears. It will be seen that no conflicting gear trains can be in action at the same time, for example, the back gears do not begin to mesh with their mating gears until the handle *C* (assumed for the moment to be in position 8) is moved past position 11. When this position is reached the lever *A* has, of course, moved the clutch *u* out of engagement. It has been shown that the sliding gears *s* and *t* can only

metrical progression. Perfect accuracy is unattainable owing to the necessary use of integral numbers of teeth for gears.

The estimated pressure on the teeth of the gears *p* and *q*, at the slowest speed, is about 4000 pounds, but taking into account the small pitch-line velocity it is assumed that they will be strong enough for any work put on them.

It will be noticed that, whereas the driving pulleys make 300 revolutions per minute, the fastest spindle speed is only 250; this is accounted for by the fact that one pair of transmission gears, between the gear box and the spindle, are in the ratio of 5 to 6.

German Portable Electric Drilling Machines

Are Adapted to Many Uses—Drilling, Tapping, Reaming, Lapping, Grinding, Rolling Boiler Tubes, as Stationary Tools, and the Like

BY DR. ALFRED GRADENWITZ

Portable electric-motor driven drilling machines have been developed to a great extent in Germany, because of their convenience, adaptability and particular usefulness on large work. They are not only used for drilling, but also for tapping, reaming, lapping, grinding, polishing, the rolling of boiler tubes, as stationary bench drills by the use of a stationary drill column, and for other purposes. The accompanying half-tone illustrations, Figs. 1 to 9, inclusive, show representative German portable electric drilling machines in use for a variety of purposes. The illustrations were made from photographs from the plant of Siemens-Schuckertwerke, Charlottenburg, Germany.

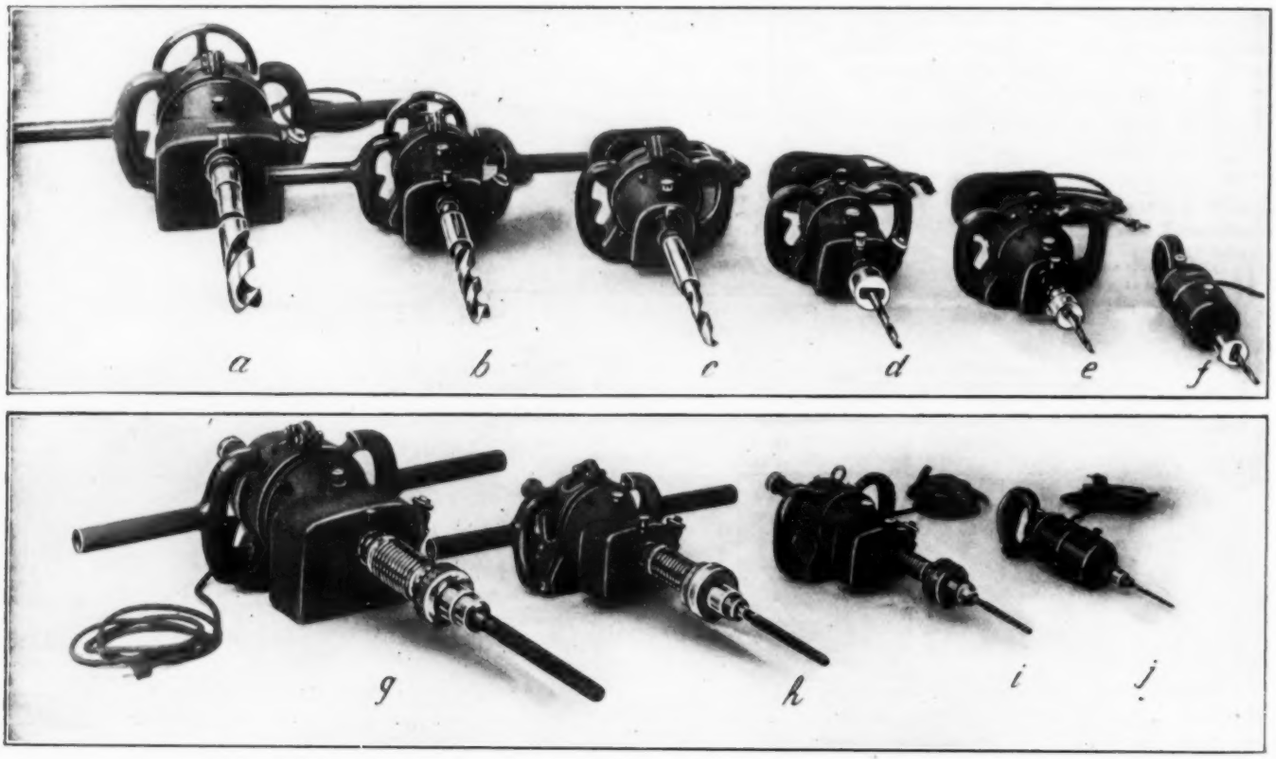


FIG. 1. GERMAN PORTABLE ELECTRIC DRILLING AND TAPPING MACHINES

Turning to Fig. 1 the upper row of machines is fitted with spindles or chucks to hold drills, and as shown each machine is equipped with a twist drill. The lower row shows the same kind of machines adapted for tapping, and each machine is provided with a combination drill and tap. Such machines are designed for either a constant speed or for variable speed, as required. Other machines are provided for two different speeds through the use of two spindles which have different rates of rotation. By means of suitable gearing either spindle can be thrown into use as desired. For work of a uniform character the single-speed machine is, of course, preferable; but for work which may range largely in the size of holes and hardness of material in which the holes are drilled, the two-speed machine is preferable.

The holding devices for these machines should be noted. Referring to Fig. 1, machines *a*, *b*, *g* and *h* are provided with heavy bar handles, as they are adapted to severe work. Machines *c*, *d*, *e* and *i* are provided with small, closed handles on the sides, while the smallest machines, *f* and *j*, are provided with a spade handle, or D-handle at the rear. These two latter machines are, of course, intended to be held with one hand.

The smallest sizes are intended to be held against the work by hand and fed by hand, while the larger sizes are intended to be blocked against a support of some character and are provided with a screw feed at the rear. In connection with the larger sizes the handles can be lengthened by the use of extensions if desired, in order to make them more easily operated in difficult positions.

As shown in the illustration, the left-hand handle of each one of the two-handled machines is provided with a switch, which is intended as a cut-out for breaking the circuit and stopping the machine.

The machines shown in the lower row—especially adapted for tapping operations—are arranged for slower speeds of rotation than the machines that are intended for drilling exclusively. The larger sizes of this type have two speeds of rotation, and the smaller sizes only one. In the case of the larger sizes, the higher speed may be used for drilling if desired, and the slower speed for tapping. Each of these machines is provided with a switch, whereby the machine can be reversed. This feature is, of course, indispensable for a machine to be used for tapping.

In order to protect the machine against injury through the binding of the taps, or for any other cause, an elastic or flexible member is inserted between the tap chuck and the machine spindle. This feature shows plainly in the illustration, Fig. 1, in the machines indicated by the letters *g*, *h* and *i*. The taps used with this machine are either provided with a drill point or else with a pilot, as the operator has less control over the direction taken

by the tap than if the connection between the tap and the machine itself were rigid instead of flexible.

The smallest machine shown in the group, indicated by the letter *J*, is not provided with this flexible coupling, as the machine is small and is adapted only for tapping very small holes. In general the taps used with these machines are very long-tapered taps, similar to nut taps, in order that the thread may be cut easily and at a single pass of the tap.

Combination Portable and Bench Drills

A combination portable and bench drill is shown by the half-tone illustrations, Figs. 2, 3 and 4. In Fig. 1 the drill is shown as a bench drill adapted for small drill-press work. Fig. 3 shows the drilling machine itself, about to be removed from the drill-press column. Fig. 4 shows the portable drill removed and in use to drill a hole in a large casting lying on the floor. On the bench beside the operator can be seen the bench-drill column, with the lever-feeding mechanism and spindle. This arrangement presents a most convenient tool for situations where a portable drill is needed only at intervals. When not required for heavy work where the portable feature is essential, it can be arranged on a bench-drill-press column and used as a regular upright drill press. The simplicity of the mechanism, whereby it is very easy to change the drilling machine from one class of work to the other, is well illustrated by the mechanism, as shown in the three illustrations. The machine itself is held in place by means of two thumb nuts, and the spindle of the machine is coupled to the spindle of the drill-press columns by means of a simple screw coupling.

A certain amount of drilling capacity is lost when the drilling machine is attached to the column, owing to the friction of the additional spindle and feeding device. This is variously estimated at a reduction of from 15 to 20 per cent. This reduction of capacity, of course, applies only to drilling, as when arranged on the drill-press column it can tap as large holes as can be tapped by hand, using the machine as a portable tapper.

The size illustrated can be transported by two men, and thus present a small bench drill press that is portable and that can be readily moved from place to place, as work or other conditions require. This is claimed as a considerable advantage over the ordinary type of belted drill press.

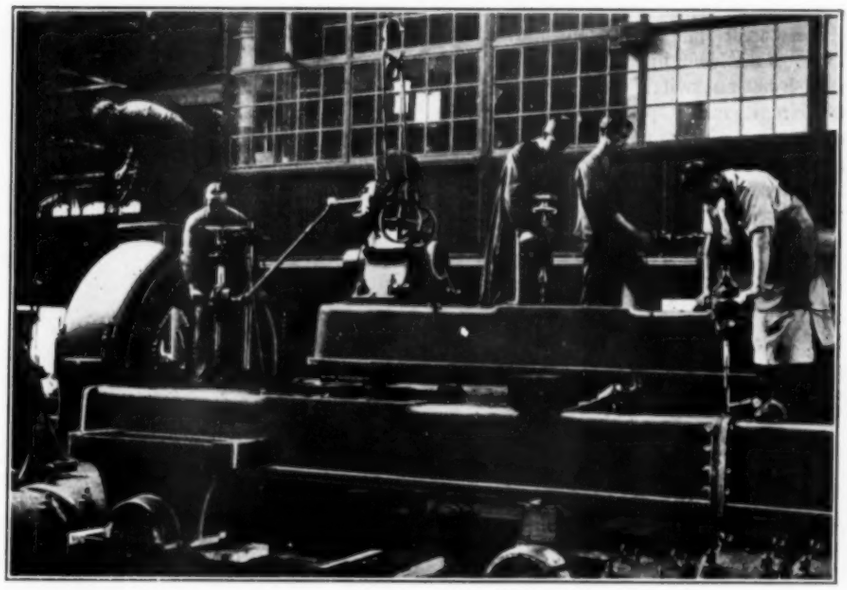


FIG. 5. SEVERAL PORTABLE GERMAN TOOLS AT WORK ON LARGE CASTINGS

Portable Drills for Large Work

Turning to Fig. 5 we see a number of portable drills at work on some large bedplate castings. The various positions that they occupy show to good advantage the character of the work for which they can be used. At the left of the illustrations can be seen a heavy portable drill, driven through a universal jointed shaft from a motor suspended by a sling. The supports for this larger drill can be seen plainly.

Portable Bench Drills

A row of portable electric bench drills is shown by the illustration, Fig. 7. These are in use and the variety of work for which they are adapted is shown plainly.

FIG. 2

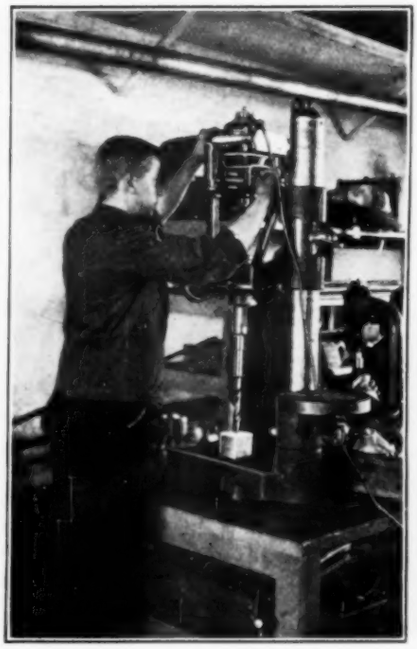


FIG. 3

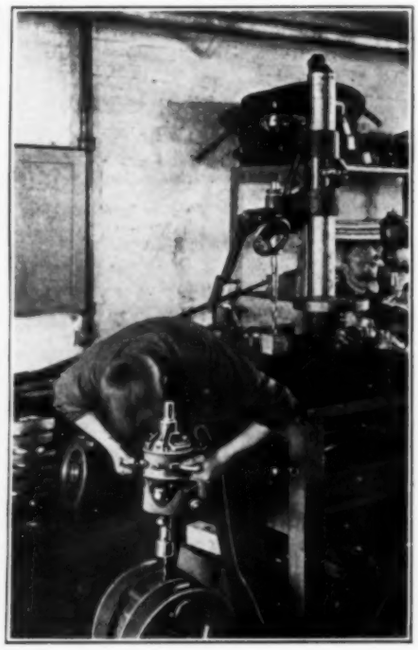


FIG. 4

A GERMAN PORTABLE ELECTRIC DRILL ADAPTED AS A BENCH COLUMN DRILL

These small drills are provided with a drilling table that is lifted by means of a lever. This lever in turn is provided with a push-button switch that serves to open the circuit and stop the drills when desired. One advantage of these drills is the possibility of grouping them for particular operations as they occur. By this means it is possible to arrange as many spindles as are desired in the most convenient grouping, in order to perform all of the drilling, reaming, tapping and counterboring operations on a given lot of pieces. The advantages of such a system of arrangement are very real in connection with highly organized manufacturing.

FIG. 7. A GROUP OF GERMAN PORTABLE ELECTRIC BENCH DRILLS

Boiler-tube Rolling Machine

The adapting of a portable electric-driven drilling machine to the operation of rolling boiler tubes is shown by the illustration, Fig. 6. Here the drilling machine is mounted on a convenient wooden box or platform. To the drill spindle, through a flexible coupling, is attached a bar carrying on its end the tube-expanding tools. This bar is passed into the interior of the boiler and the rolling operation is carried out without difficulty.

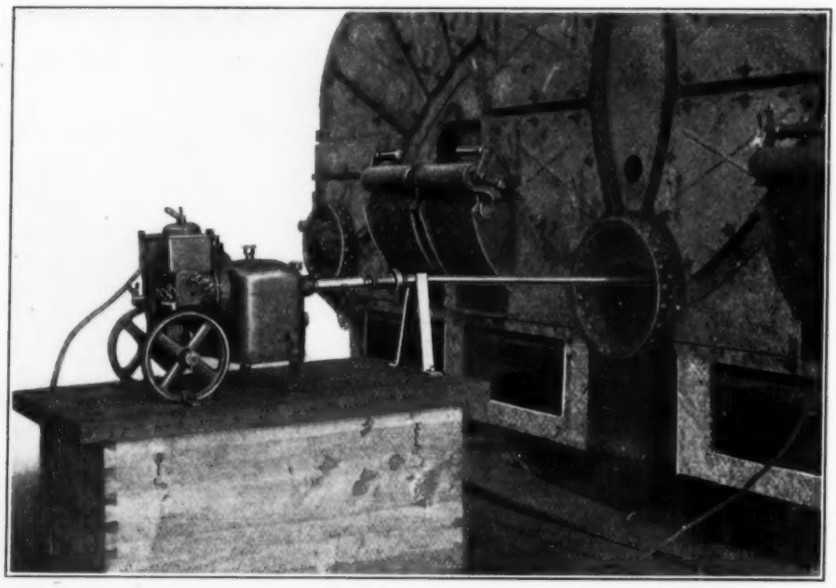


FIG. 6. GERMAN DRILLING MACHINE USED TO ROLL BOILER TUBES

Other Uses

Fig. 8 shows one of these machines used for driving a lap in the operation of lapping some tool-steel bushings. The machine is held in a bench vise in a horizontal position and presents a rapidly revolving lap in a very convenient position for the operation of lapping. The last illustration, Fig. 9, shows a similar machine used for rough-grinding. The bracket carrying the emery-wheel shaft is provided with hand grips on each side, in order that the operator may easily hold it and bring it in contact with the work as desired. Here a flexible shaft connects the spindle of the drilling machine with the arbor of the emery wheel. In a similar manner, polishing wheels, buffing wheels, wire brushes and similar appliances can be adapted to the particular needs of the work that is in hand.

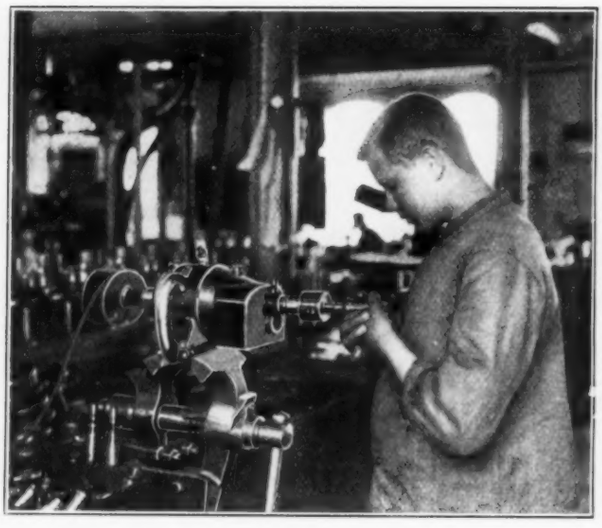


FIG. 8

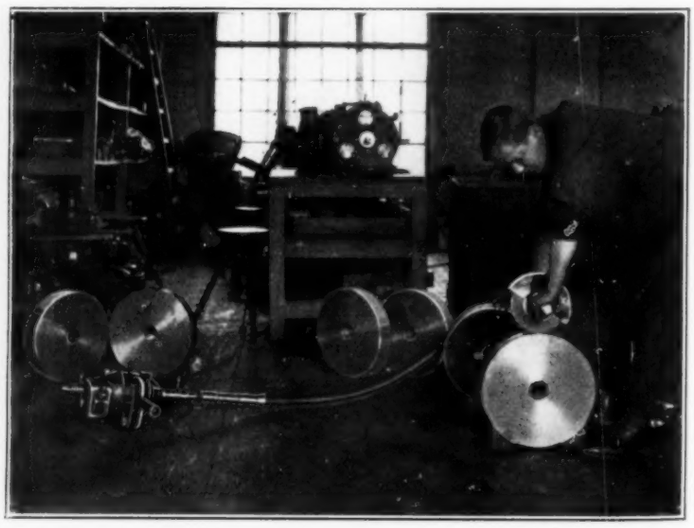


FIG. 9

LAPPING AND GRINDING WITH GERMAN PORTABLE ELECTRIC DRILLING MACHINES

Steel Belts for Power Transmission Purposes

For Equal Service They Are Lighter, Narrower, Cheaper and Can Run at a Higher Speed Than Leather Belts or Ropes

CONDENSED TRANSLATION

Steel belts, or metal belts, are by no means unknown, yet they are not generally used and are considered as particularly unadapted for heavy duty. Thus the development of steel belts for heavy power-transmission service in Germany is of more than passing interest. The subject of this article is the steel belt development of the Eloesser-Kraftband-Gesellschaft, of Berlin, Germany.

As would naturally be expected, the joint or splice of a steel belt is one of the critical features. The joint construction used by this German firm is illustrated by Fig. 1. It consists of two steel plates, an under and an upper, between which the ends of the belts are joined. These plates taper from a thickened section at the center to comparatively thin edges. In the size illustrated, the upper plate is made with a series of holes in order to lighten it. Both of these plates are shaped to a circular arc, whose radius is equal to the radius of the smallest pulley on which the joint is to be used. Thus, for a given joint there is a minimum limiting diameter of pulley on which it can run, but no similar maximum limiting diameter; for a given joint can be used on pulleys of any diameter larger than the one to which the plates are particularly fitted.

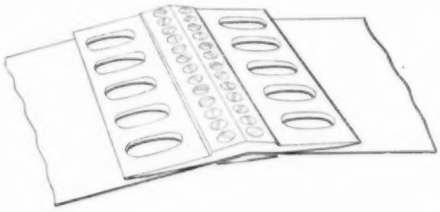


FIG. 1. JOINT OF A GERMAN STEEL BELT

The belt itself is made of a uniform quality of steel of an even thickness and is tempered. The ends are carefully brought together, fitted and soldered with a special solder that flows at a comparatively low temperature. This joining is then placed between the two plates that we have described, and these plates are fastened together by means of screws, as shown in the illustration, Fig. 1.

Advantages

A number of interesting claims are made for these belts. Three of the most striking are: The small amount of slipping of the belt on the pulley, given in figures as less than 1/10 of one per cent., the narrow width of the belt compared with leather belts, the proportion being about 1 to 5, and the great speed at which these belts can be run, given as 100 meters per second, or say 19,000 feet per minute. This latter figure is striking if we compare it with the factor usually given for leather belting as 4000 feet per minute. It is very common to run these steel belts at a speed of 50 meters per second, or say, roughly, 10,000 feet per minute.

Item.	Rope Drive.	Leather-belt Drive.	Steel-belt Drive.
Breadth of belt space	6 ropes 45 mm. in diameter	500 mm.	100 mm.
Breadth of pulley	380 mm.	500 mm.	110 mm.
Weight of pulley	1000 kg.	520 kg.	270 kg.
Weight of rope or belt	240 kg.	140 kg.	13 kg.
Total weight of drive	1240 kg.	660 kg.	283 kg.
Cost of pulleys	720 marks	400 marks	250 marks
Cost of ropes or belts	600 marks	1300 marks	750 marks
Total cost	1340 marks	1700 marks	1000 marks
Power lost in per cent	13%	6%	0.5%
Power lost in horsepower	13 h.p.	6 h.p.	0.5 h.p.

FIG. 2. COMPARISON OF ROPE, LEATHER BELT AND STEEL-BELT DRIVE

Other minor advantages which are really dependent upon the three major ones that we have pointed out are: A narrower and lighter pulley for given service, a lighter and smaller shaft, a reduction of the strains upon bearings (thereby a reduction of the size of bearings and in many cases—especially on electrical machinery—the elimination of outboard bearings), a saving of room through a reduction of the general dimensions of machinery, avoidance of temperature and humidity effects (thereby a lessening of the required attendance) and, in case the belt is applied to existing pulleys, the possibility of using the pulley face for other belts. This last feature is particularly true of portable engines.

Because of the high permissible speed these belts have been adapted in many cases to electrical machinery, both generators and motors, and to gas engines. They have also been used for driving belts in machine shops and other manufacturing establishments. The table, Fig. 2, gives some comparative data between a rope drive, a leather-belt drive, and steel-belt drive for 100 horsepower, transmitted by pulleys 10 meters, 30 feet, apart at a speed of 200 revolutions per minute and a diameter of 1 meter, 3 feet. The metric measurements in the table are not translated into English measurements because the table is of comparative interest only.

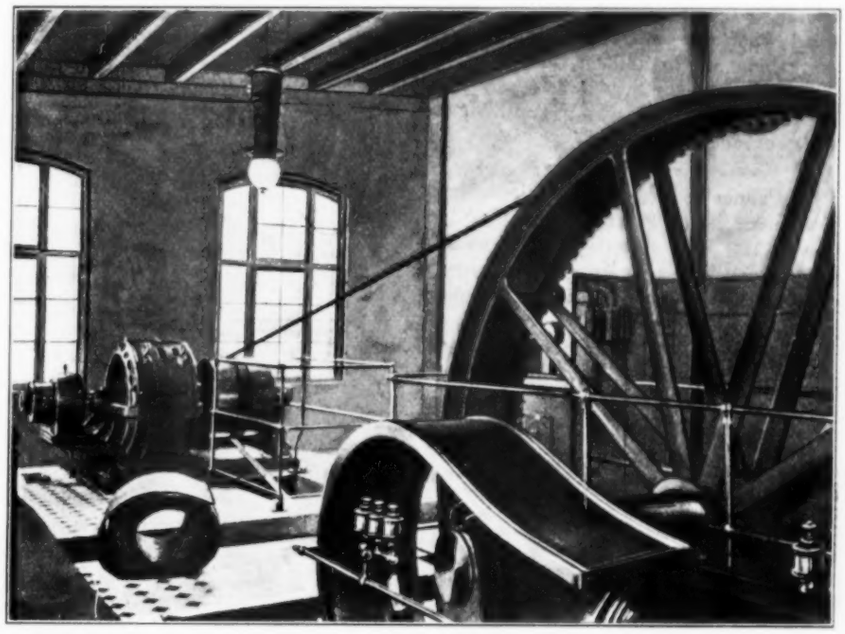


FIG. 3. A 250-HORSEPOWER STEEL BELT DRIVE

Fig. 2. Comparative dimensions and costs of a 100 horsepower drive in rope, leather belts and steel belts.

Representative Installations

Turning to the half-tone illustrations, Fig. 3 shows a drive on a steam engine at the plant of Ludwig Sudicatis & Company, Berlin, from a 250-horsepower steam engine to an electric generator. The width of the steel belt is 100 millimeters, or say 4 inches; the width of the leather belt which was removed, and which is seen lying on the floor, is 600 millimeters, or say 24 inches. The striking feature of this illustration is the narrowness of the belt.

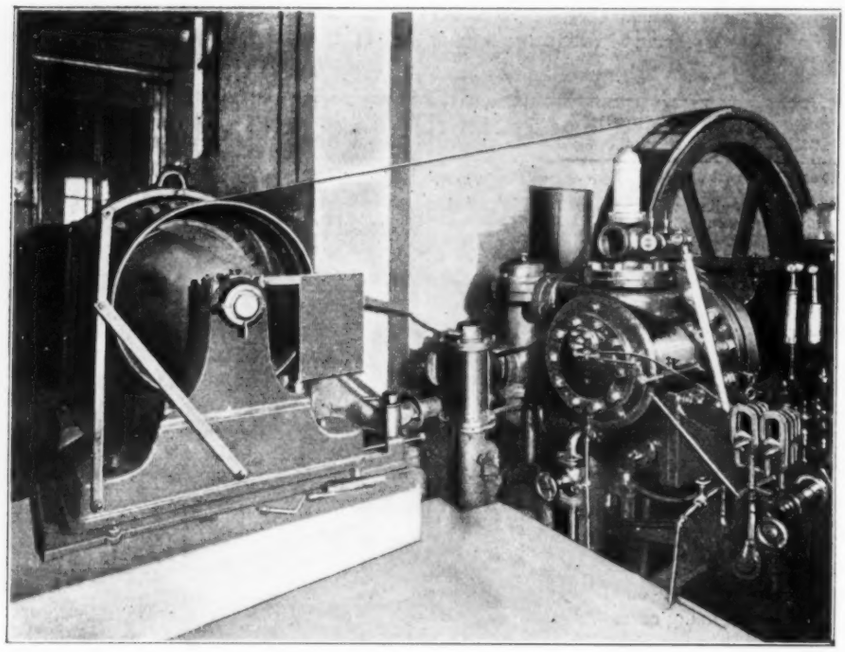


FIG. 4. A 160-HORSEPOWER STEEL-BELT DRIVE

Fig. 4 shows a drive in the plant of the Berliner Elektrizitatz-Lieferungs-Gesellschaft, Berlin. It transmits 160 horsepower, and the breadth of the belt is 100 millimeters, or say 4 inches. The leather belt that it replaced was 280 millimeters wide, or about 11 inches.

The annual report of the United States Commissioner of Patents shows that during the last fiscal year there were received 58,527 applications for mechanical patents, 1091 applications for designs, 207 applications for reissues, 7467 applications for trade-marks, 810 applications for labels, and 339 applications for prints. There were 34,902 patents granted, including reissues and designs, and 6135 trade-marks, 636 labels, and 279 prints were registered. The number of patents that expired during the year was 24,270. The number of allowed applications which, by operation of law, were forfeited for non-payment of final fees was 6520. The total receipts of the office were $1,874,180, and the expenditures $1,608,292, leaving a surplus for the year of $265,888.

A Peculiar Bit of Cam Designing

By Entropy

Here is a rather peculiar bit of design that I ran up against a short time ago. Fig. 1 shows roughly a press. The plunger *a* had to make a stroke of about 1½ inches and return in one-ninth of a revolution, then in the next ninth of the revolution it had to make a stroke of one-eighth of an inch and return and then during the remaining seven-ninths of the revolution it was to remain stationary at the top of its stroke.

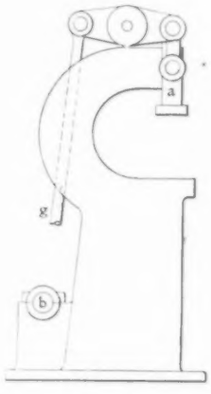


FIG. 1

The problem was plainly one for a cam and seemed simple enough until some experimenting with the materials, on which we were working, showed that it would be necessary to provide for a possible pressure of five or six tons on the second, or short stroke. A cam with a pin that would carry this pressure would not leave us room enough in the shop to swing a respectable sized cat. I finally struck on a combination of cam and crank shown in Fig. 2. Here *b* is the main driving shaft, *c* a crank pin some four inches in diameter, *d* a slotted yoke, bearing on a square block *e* on the crank pin. The slot in *d* is of such a length that at the lowest point in the stroke of the connecting rod *g* the top of the block *e* comes in contact with the top of the slot. Then for one-ninth of a revolution the crank carries the connecting rod, the cam groove *h* is cut out a trifle large from *k* to *l* to make sure that it does not bear. It is evident that the connecting rod *g* will have a vibratory motion as well as a reciprocating one.

The appearance of the mechanism in action is very much like the ordinary crank and rod gone crazy. That we had to resort to strange expedients is also shown by the fact that we had another plunger working inside of *a*, Fig. 1, actuated from the same shaft by another cam which was fixed on the end of the crank *c*, and served to keep yoke *d* from coming off.

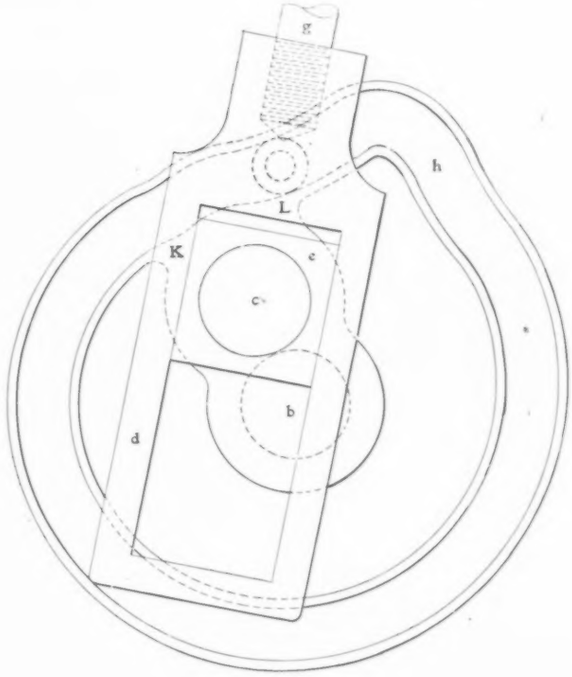


FIG. 2

A PECULIAR CAM AND CRANK MOTION

A floating microscope was recently placed at the Harvard observatory. It is of the reflecting type, and is purported to be the largest in existence, the object mirror measuring 5 feet across.

Practical Letters from Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

Locating the Intermediate Center

In laying out work the draftsman occasionally has to determine the coördinates of a point that is at certain given distances from two fixed points, as in locating the center of an idler gear where the centers of the driver and driven gears are already fixed. When the centers of the driver and driven gears are on the same horizontal line or on the same vertical line the problem is in its simplest form. In Fig. 1 the centers B and C are in the same horizontal line, the distance from B to C is a and is fixed. The center A must be at a distance of c from B and also at a distance of b from C. The rectangular coordinates x and y are required. When $c+b=a$, A is on the line a, $x=c$ and $y=0$. The case of $c+b<a$ is impossible. When $c+b>a$, as shown in Fig. 1, $x^2+y^2=c^2$ and $(a-x)^2+y^2=b^2$. Whence

$$x=\frac{c^2-b^2+a^2}{2a}.$$

Having found the value of x the value of y may be found from

$$y=\sqrt{c^2-x^2}.$$

To check the work: take the value of x as found and determine y again from

$$y=\sqrt{b^2-(a-x)^2},$$

and if this equation gives the same value for y as that already found the work is correct.

When the fixed centers B and C are neither on a horizontal nor a vertical line, as in Fig. 2, the problem is more complicated and in order to have the work check it is necessary to be very accurate throughout the various steps of the calculation, particularly so when the angle at A is either large or small. If the distance from B to C may be varied slightly, the following method will be found satisfactory; it also effects a considerable saving in time in the calculation: Carefully lay off the points B and C in the desired positions, using as large a scale as convenient, then with a radius equal to c strike an arc with center at B and with a radius equal to b strike an arc with center at C intersecting the first arc in the point A. Measure x and calculate y or *vice versa*. If it is desired to have the variation in the position of C in the horizontal direction, take d as given and determine e, which in this case is unknown, from

$$e-x=\sqrt{b^2-(y+d)^2},$$

which gives

$$e=\sqrt{b^2-(y+d)^2}+x.$$

By laying off e with this value on the layout it will be seen whether the center

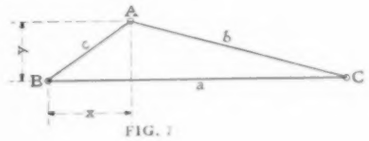


FIG. 1

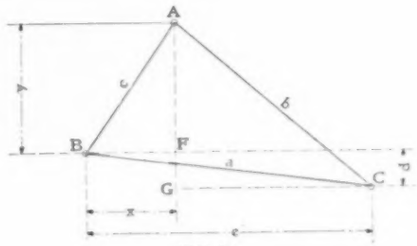


FIG. 2

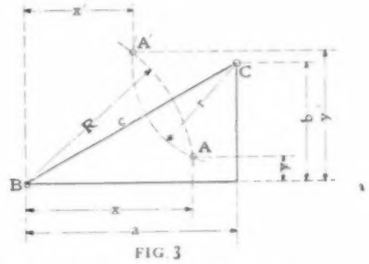


FIG. 3

DIAGRAM FOR DETERMINING AN INTERMEDIATE CENTER

C comes within the allowable variation from the desired location.

When the variation in the position of C is desired in the vertical direction, take e as given and determine d, which is now unknown, from

$$d+y=\sqrt{b^2-(e-x)^2},$$

which gives

$$d=\sqrt{b^2-(e-x)^2}-y,$$

and by laying this off on the layout it will show if the location of C is within the limit. If C does not fall near enough to the desired position, x may be altered in case the variation is horizontally, or y in case it is vertically, and the calculation repeated. The recalculation will seldom be found necessary unless the allowable variation is very small.

When the location of B and C cannot be changed, either of the following methods may be used. The first or trigonometric is in common use. It depends on trigonometric principles, but one need not have an extensive knowledge of trigonometry to make use of this method. About all that is required is to be able to correctly take the functions of the angles from sets of tables.

In the second method trigonometry is entirely dispensed with and for that reason might be preferred by some. There is about the same amount of work and the degree of accuracy is about the same in calculating by the two methods, but the second method would be quicker and present less chance for error for some on account of its being purely algebraic:

First Method

Subtract the angle FBC from the angle ABC (Fig. 2) obtaining the angle ABF. Then as triangle ABF is right angled at F, side c and angle ABF are known; x and y are found from $x=c\times cos.\ (ABF)$ and $y=c\times sine\ (ABF)$ or

$$y=\sqrt{c^2-x^2}.$$

To find angle FBC, divide d by a to obtain the sine then look in the table of sines for the angle whose sine has the value $\frac{d}{a}$ which is the required angle. To find angle ABC, use the formula

$$cos.\ (ABC)=\frac{c^2+a^2-b^2}{2ac}$$

and look up the angle in the table of cosines.

Second Method

Let B and C (Fig. 3) be the fixed centers as before and it is required to locate the intermediate center at a distance of R from B and r from C. It is evident from the figure that there are two points A and A' which will satisfy the conditions, except when $R+r=c$ in which case A is on the straight line c connecting B and C and $x=a\frac{R}{c}$ and $y=b\frac{R}{c}$.

When there are two points as in the figure, the one to be used may be determined from an inspection of the layout and the calculations for x and y or x' and y' made accordingly.

From the figure $a^2+b^2=c^2$ and for

convenience let $a^2+b^2+R^2-r^2=D$; then

$$y=\frac{b\,D}{2\,c^2}-\sqrt{\frac{a^2\,R^2}{c^2}-\frac{a^2\,D^2}{4\,c^4}}$$

and

$$x=\sqrt{R^2-y^2}\;;$$

or

$$y=\frac{b\,D}{2\,c^2}+\sqrt{\frac{a^2\,R^2}{c^2}-\frac{a^2\,D^2}{4\,c^4}}$$

and

$$x'=\sqrt{R^2-y'^2}\;.$$

This formula is in convenient form for the use of logarithms and their use is recommended.

Time and confusion will be saved by arranging the work similar to the following:

$a=$	$log.\ a=$	$log.\ a^2=$	$a^2=$
$b=$	$log.\ b=$	$log.\ b^2=$	$b^2=$
....	.....	$log.\ c^2=$	$c^2=a^2+b^2$
$R=$	$log.\ R=$	$log.\ R^2=$	$R^2=$
$r=$	$log.\ r=$	$log.\ r^2=$	$r^2=$
$D=$	$log.\ D=$	$log.\ D^2=$	.....

Substitution can now be conveniently made in the equation for y or y' whichever is desired. When y or y' is determined the corresponding x is found from the simple equation as given, which is for the second leg of a right-angled triangle having one leg and the hypotenuse.

No matter what the variation in the proportions and location of the figure may be in practice the rules as given may be applied. To save confusion a sketch should be made and the dimensions and angles added to it as the work progresses. The proper algebraic signs should be used throughout the work or allowance made in case they are not. To check the work, (see Fig. 2) calculate the vertical side $A\,G$ of triangle $A\,C\,G$ taking the value of the base $C\,G=c-x$. If x, as found, is correct and the calculation of the proof is also correct then $A\,G$ will be $=y+d$ which proves x and y. The base may be calculated instead of the vertical side if preferable. The same proof is also used in the second method.

In these calculations, equations of the form $y=\sqrt{c^2-x^2}$ frequently occur. In solving them by logarithms the work is reduced by making use of the algebraic principle that "the product of the sum and the difference of two quantities is equal to the difference of their squares," or algebraically $c^2-x^2=(c+x)\ \ (c-x)$.

Arrange the work as follows:

$$\frac{\begin{matrix}c\\x\end{matrix}}{c+x}=sum\ of\ quantities.$$

$$c-x=difference\ of\ quantities.$$

$log.\ (c+x)=$ .....

$log.\ (c-x)=$ .....

$$logs.\ added=\left[\begin{matrix}log.\ (c+x)\\+log.\ (c-x)\\=log.\ (c+x)\ (c-x)\\=log.\ (c^2-x^2)\end{matrix}\right]$$

$$\frac{log.\ (c^2-x^2)}{2}=log.\ \sqrt{c^2-x^2}$$

$$=log.\ y.$$

St. Louis, Mo. E. E. GRAHAM.

A Makeshift Taper Attachment

Some time ago while employed in a small contract shop in the West I was confronted with a job as here described: A large thimble for a wagon-wheel hub, 20 inches long and ½ inch thick, required

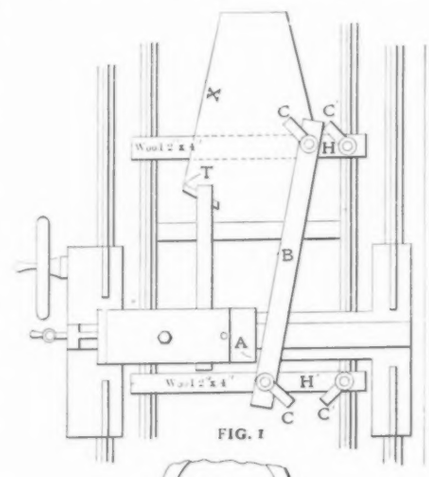


FIG. 1

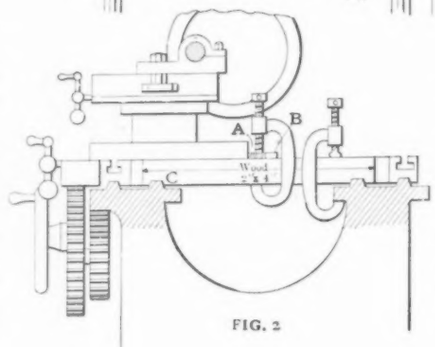


FIG. 2

DEVICE FOR BORING TAPER HOLES ON THE ENGINE LATHE

to be bored taper from 8½ inches at the larger end to 6 inches at the small end. Having no taper attachment for the lathe, a 30-inch Lodge & Shipley, I devised the scheme as shown in cut. *H H'*, Fig. 1, are two strips of wood, notched to fit the inside V's of the lathe and secured to them by clamps *C C'*.

B is a wrought-iron bar, the inside edge planed straight as a guide to cross-feed and secured to strips by clamps, as shown in Fig. 2.

Line *X* shows the travel of the tool, the cut being started at *T*. Strips are made high enough that the bar passes freely over the carriage, allowing the cross-slide to bear against it. Taper is set by trying the carriage to and fro the distance of the length of the bore and measuring with a scale from the outside of the cross-slide to a line on the edge of the carriage. After the bar is set, the cut is started at *T*, the tool being fed to the cut by the compound rest slide. After engaging the parallel feed the cross-feed slide is kept against the straight edge of the bar by feeding it in by hand as the carriage travels ahead. I found the scheme worked nicely.

I set my caliper to 8½ inches by a scale and when the job was taken out of the lathe I could just insert a 6-inch scale in small end, having a true, smooth hole.

Boise, Idaho. STANLEY EDWARDS.

Queer Things About Forgings

When one has worked on forgings of all kinds, and for nearly all purposes, for 27 years and does not run against anything out of the ordinary, he is either remarkably lucky or his perception is so dull he does not care why his ordinary calculations go wrong and lead him astray. I was always an investigator and, when anything went wrong, tried to figure out where it had gone wrong and thus fortify myself for the next time. The first time my confidence sustained a perceptible jar was when I had to draw a number of bars from 2x4 to 2x3 inches. It requires no elaborate amount of calculation to figure that there is not double the amount of stock in the larger piece that is in the smaller, yet this piece drawed under an 800-pound steam hammer, just 2 for 1, or 1 foot of 2x4-inch wrought-iron bar made 2 feet of 2x3-inch bar.

I am convinced from experience that a small portion was lost by oxidation, in the furnace, but notwithstanding that I gained a quarter of an inch in 1 inch of length, and by what means I could never see.

Next reverse the process and upset a 2x3-inch bar 2 feet long back to a 2x4-inch bar and you have a piece 2x4 inches, that is 8¼ inches long and no more. Where has our 2¾ inches of stock gone to in the upsetting process? As I said before some is lost by scale, perhaps one-fourth or one-half pound but not a section 2x3 inches and 2¾ inches long.

This is further proved by upsetting die blocks from 4x4-inch billets. I have had a great many of these to make, for forging press dies, and should the rough piece require a length of 30 inches, or only 6 inches, for the forged die, we allowed exactly the same amount for waste on one as the other, and always came out right: viz., 3/16 inch over finished size.

When we first began making these steel blocks, they were all made from 4x4-inch billets which ran all sizes and shapes. Our superintendent gave me an order for about two dozen, some to be cut hot and some to be cold-sawed. He did the figuring for lengths, and by the way, he

was an artist at figures, but there was not a block in the whole lot that worked out to what we wanted it to. We made use of some by taking the longest pieces for the shortest blocks and put aside the shorter pieces to experiment with.

By taking a piece exactly 12 inches long and calculating for a given finished dimension, it did not take me long to find out that 25 per cent. must be added to the total square inches contained in the piece to make the desired section contained in the die and generally we gave ½ inch for good measure. We often found we needed this and were ready to kick ourselves because we did not add more, especially where the block got out of square to some extent.

I have run against this same proposition in making blanks for gears and have never seen the man yet that would not figure below the required amount. Generally 10 per cent. was added so as to be sure and have enough stock, but it would invariably be scant.

These are a few things I have noted in my experience that I can find no explanation for and therefore would like to have a comprehensive explanation of them from my fellow readers, if some of them will kindly open up their knowledge box and send their reasons for these peculiarities to the AMERICAN MACHINIST.

St. Louis, Mo. T. TOOT.

Making a Flue Cleaner

There is a little machine shop in South Bend, Ind., run by William Maurer, that recently commenced the manufacture of an automatic flue cleaner having the brush bristles made of flat spring steel. The way he overcame the handicap of a punch press too small to do the work the way he would have liked to do it, is interesting.

He can punch out any size bristle plate he needs on his little punch press with one punch and die, and while it takes a little longer time this way, a boy does the work, and it is sufficient for the present demand. Fig. 1 is a top view of his double-indexing die with a punched bristle plate in position. Fig. 2 is a bottom view of the mechanism removed from the die plate. Fig. 3 is the die plate to which is fastened the cross-index arm *H*, into the notches of which the locking device *A*, Fig. 2, meshes, the two bars *B B* fitting into slots in the die plate. The regular indexing is done by means of the dog *C* engaging the notches, as shown.

In use the bristle plate is set in the proper position and one row of holes punched parallel to the long way of the plate. It is then set for the next row by moving *A* up one notch and so on.

The spring wire bristles are made on the combination bending punch and shear, shown in Fig. 4. The flat spring is fed off of a reel from the left against the stop *W* and sheared off and bent at one stroke, the finished bristles being shown on each side of the punch. The bristles are slipped through the holes punched in the bristle plate and wired in by hand.

Decatur, Ill. ETHAN VIALL.

Removing Bushings by the Use of Hydraulics

One day a shop-mate of mine demonstrated to me a novel way in which he extracted some hardened bushings from

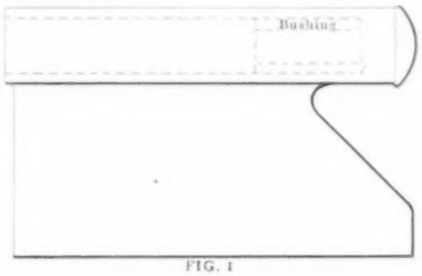


FIG. 1

FIG. 2

REMOVING A BUSHING

the bottom of a chamber in which they were a forced fit. He put the question this way: "How would you extract a hardened bushing from the bottom of a deep chamber like this (see Fig. 1) without drilling any holes in the casting?" Of course I was "up against it" as doubtless a great many more mechanics would be. Fill the bushing with oil, and insert a long plug which is just an easy fit in the bushing, then give it some sharp blows on the end and it will start every time; if the chamber is quite deep put more oil in the bushing as it comes up. The only case where it would not work would be if the end of the bushing and the bottom of the chamber were perfectly square and lapped a perfect fit, so the oil could not be forced back of the bushing. Another instance to use this method would be where two bushings were forced in the same sleeve as in Fig. 2; fill with oil and force in loose plugs from both ends at the same time; if one bushing tends to come out before the other, clamp something over the end of the sleeve until the other bushing has started; in this way they will come out without being marred.

Elgin, Ill. A. J. DELILLE.

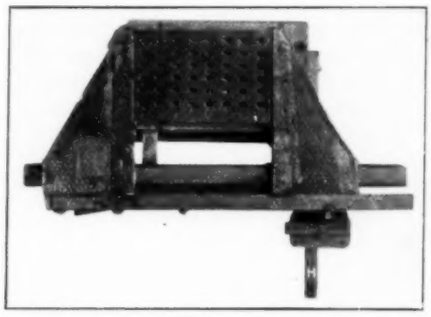


FIG. 1. TOP VIEW OF DIE WITH PUNCHED PLATE IN PLACE

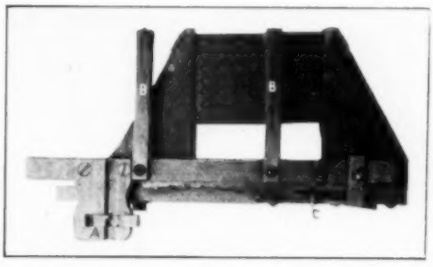


FIG. 2. BOTTOM VIEW OF THE MECHANISM

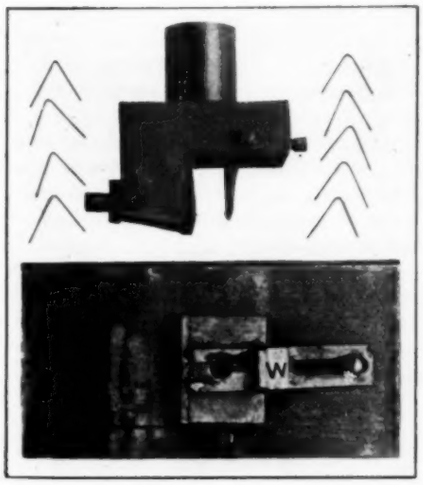


FIG. 4. THE PUNCH, DIE AND BRISTLES

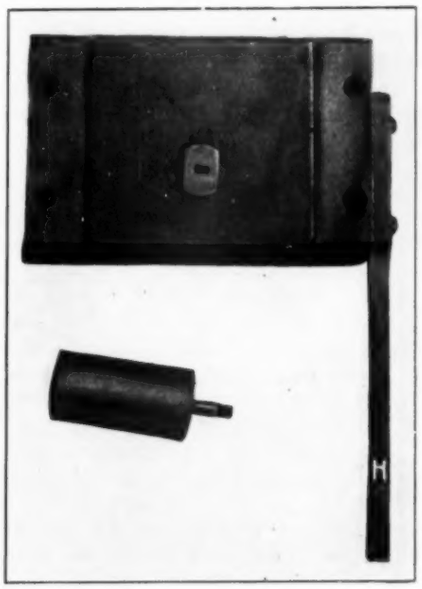
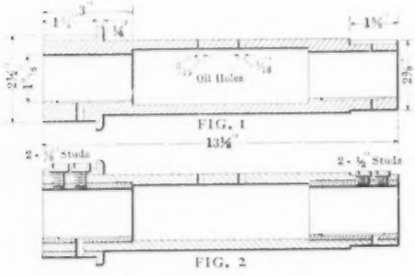


FIG. 3. THE DIE-PLATE AND PUNCH

A Repair Job on an Automatic

The accompanying figures show an interesting repair job on a Potter & Johnston triple-gear automatic, which enabled the time of the machine to be saved for at least a week while waiting for a spare part from the builders. The original sleeve of cast iron, Fig. 1, carried a gear keyed on at each end and rotated on a 1 9/16-inch shaft. The failure occurred at the oil holes near the center, from the torsional stresses set up by the transmission of the power through the sleeve. The



A REPAIR JOB ON AN AUTOMATIC

thickness of the sleeve was 5/16 inch and it was doubtless materially weakened by the two 3/16-inch oil holes located as shown. The new sleeve, Fig. 2, was made of cold-drawn steel "lap roll" tubing 2½ inches outside diameter and 1⅞ inches inside diameter. Both ends were bored out to 2 inches diameter to receive two 3x2x1 9/16-inch phosphor-bronze bushings, which were driven in and served as bearings for the sleeve on the shaft. On one end of the sleeve a forged steel flanged ring or collar was shrunk on to provide sufficient stock, for the studs inserted to take the place of the key and to provide a shoulder for a bronze sleeve rotating outside. Two ⅝-inch diameter studs were set into this ring, counterbored ⅝ inch and tapped ⅜ inch. The portion of these studs above the surface was flatted to ½ inch and the two together served as the key. On the opposite end two ½-inch studs were used in a similar way flatted to ⅜ inch. In this simple way the job was completed in a short time, and the strength of the sleeve is without question greater than that of the original.

Lowell, Mass. G. H. PERKINS.

Leveling Horses for Balancing Large Pulleys

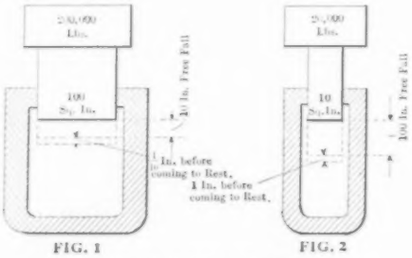
I am desirous of making an especially good set of leveling horses for balancing pulleys up to 12 feet in diameter. Can any of your readers give information that will be of assistance?

Brantford, Ont., Canada. F. A. J.

Terminal Pressures in Hydraulic Accumulators

I had occasion recently while designing an hydraulic accumulator to investigate the pressures produced in the piping system by the fall of the accumulating ram. It was desired to determine whether it was best to attain the required cubic capacity in the accumulator by using a ram of large diameter and short stroke, or of small diameter and long stroke. It is obvious that a ram of large diameter will require a weight in proportion to the area of the ram to produce any given pressure in the cylinder, or in other words, "the weight required varies as the square of the diameter." It is not so apparent, however, that the pressure produced by the fall of the large ram is in any way different from that produced by the fall of the smaller.

In Figs. 1 and 2 we have sections of cylinders having rams with areas of 10 square inches and 100 square inches, respectively. Assuming that we wish to maintain a pressure of 2000 pounds per square inch in the cylinders, we find that



DIAGRAMS OF ACCUMULATOR RAMS

the weights required (neglecting friction) are 200,000 pounds and 20,000 pounds, respectively. Now remove suddenly from each cylinder 1000 cubic inches of water and assume that the valves are instantly closed. The larger ram will fall a distance of 10 inches and the smaller one 100 inches.

Now the whole volume of water in the entire system of piping and presses is the same in both cases, and although practically incompressible, it is evident that some compression of the fluid must take place in both cases. Assuming that the smaller ram is brought to rest in a certain distance, say, 1 inch, it is evident that the larger ram will be brought to rest in a space of 1/10 inch. Now the energy produced by the fall of each ram is found by multiplying its weight in pounds by the fall in inches, which gives in both cases 2,000,000 inch-pounds.

If we now divide the inch-pounds produced by the space required to bring each ram to rest, we will have as a result the mean pressure produced on the ends of the rams. This result is for the large ram 20,000,000 pounds, and for the small ram 2,000,000 pounds. These results divided by the areas of the large and small rams, respectively, give the mean pressure produced in the piping system, or 200,000 pounds per square inch.

It is evident that the enormous pressure would destroy the piping system if relief valves were not provided, but the assumptions made will serve as a basis of comparison. We may, therefore, say, in conclusion, that the use of a ram of small diameter is preferable only on account of the less weighting required, and not on account of any difference in cylinder and piping pressures.

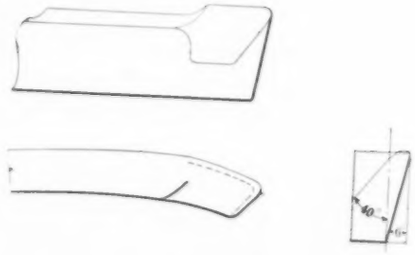
W. E. MOREY.

Rockford, Ill.

A High-speed Steel Roughing Tool

Much has been written of late of the value of high-speed steels, but almost all writers appear to be manufacturers of heavy forgings, where speeds are comparatively low with depth of cut and feeds per inch extremely heavy. My own experience on large crank shafts seems to bear out the truth of several shapes and cutting angles described by Mr. Taylor. However, this is not the point where our greatest saving is effected. On most of our small steel work heavy cuts and feeds are not possible, but considerable experience in tool shapes has led us to the use of a tool which gives satisfaction.

We find by increasing the top rake to the unusual angle of 40 degrees, as shown, cuts of ⅛ and 3/16 inch in depth, with 1/64 inch, or more, feed, with cutting speeds of 120 to 200 revolutions per minute, the maximum amount of metal can be removed without undue chattering.



A HIGH-SPEED STEEL ROUGHING TOOL

The driving power remains quite normal, and can be lived up to on some of the older types of machines whose driving power is not up to the standard of a high-speed lathe.

This extreme top rake prevents the chip curling and allows it to descend almost straight, thus decreasing the friction on the top face and allowing the tool to remain comparatively cool and sharp. By diminishing the back slope of the top face it allows the tool to be ground continuously without undue waste and simplifies forging.

Suffolk, England. S. THOMAS.

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

Rigidity Test of a 24x24-inch x 8-foot Planer

The article by Mr. Pratt, at page 545, is the first of a sort that I expect to see more often published in the future. Despite the fact that it has long been known that deflections are measures of strength, it has seemed to be left to this late day for anyone to attempt to arrive at any practical conclusions as to the desirable amount of strength to be allotted to machine-tool parts. My personal interest in Mr. Pratt's article comes from a previous association with the planer business and also quite a bit of experience in their use, and also in the fact that my article at page 873, Volume 31, Part I, on the design of such tools seemed to be in line with his experiments.

Mr. Pratt's task appeared to be to test a certain planer to discover whether the "spring" of any of the parts was excessive. This desire to know was certainly laudable, but from the point of view of the readers of the AMERICAN MACHINIST it is desirable that we should know exactly the design of the parts tested so that buyers of planers may be able to judge the probable rigidity of other planers, and so that the designers of similar machinery may have something to guide them in their work.

Since Mr. Pratt invites comment I wish to take up point by point the paragraphs of his article which appeal to a designer, not in a spirit of criticism, but to show what further information might be desirable.

THE BULL-WHEEL SHAFT

The deflection, according to Mr. Pratt's calculations should have been 0.00036 inch; the measured deflection under the same cut was 0.0015 inch, which was double that under the lighter cut. Now the deflection should be directly proportional to the load, hence if the loads were proportional to the depths of cut (?), then with a zero load the deflection would have been less than nothing, which is obviously unlikely. If I may make a suggestion, it is that possibly there is a slight play in the bushings in which the bull-wheel shaft rests (in the bed) so that a comparatively small pressure deflected the shaft enough to take up this play and then a greater force applied found the shaft practically "fixed" in position at the ends, which would make the deflection due to a given additional load only a fraction of what it would be if the shaft was only "supported" at the ends. Then, too, the load is very evidently not concentrated at the center of the length of the shaft, but is more or less uniformly distributed over the whole length of the hub of the bull gear. If the workmanship was perfect it would be uniformly distributed. This would tend to make still more difference between the observed and calculated deflections, which still more tends to make me believe that there was an error in alinement of the two holes in the bed through which the shaft passed, or else a looseness of fit, which would account for the increase in deflection. The moral of all this is that if experience shows that a 3½-inch shaft gives bearing surface enough to avoid cutting, it is plenty stiff enough to compare with the rest of the machine; and also that careful workmanship here would be an excellent help in the prevention of chatter. No tests were made to find the effect of the necessary looseness of fit in the bull-wheel hub. The chances are that there was enough more there to make the legitimate deflection of the shaft rather small.

DEFLECTION OF PLATEN

I cannot avoid a feeling that the method of measuring the settling of the platen may have really measured to some extent the deflection of the floor. Other experiments performed on a planer resting on a secure foundation would be necessary to confirm, or disprove, the opinions advanced. The lifting of the platen under the deeper cut simply shows that the sideways component of the tool pressure was too great, or the weight of the platen too small.

THE HEAD

The instrument for measuring the deflection in the head itself was placed near where one would naturally expect little spring. If the instrument had been placed back of the cutting tool and as close as practicable to the work it would probably have shown a very considerable greater movement.

THE CROSS RAIL

This is evidently the most rigid member of the whole combination as tested. What movement it showed was evidently torsion. Inasmuch as no scale drawing of the cross-section is shown, it is hard to say what could be done to remedy it.

THE HOUSINGS

It seems to me that method of arriving at the backward (or forward) deflection of the housings was too crude to be accepted. The sideways deflection of the housings should have been tested as a whole relative to some outside and stationary point. Neither deflection ought to be appreciable in any planer with the cross rail so low. It would be only on high work that the deflection would be objectionable.

If the author of this article wishes to make his work of still more value he should give detailed descriptions or drawings of all the parts under test. He should test a planer mounted on a more satisfactory foundation so that his measurements which are supposed to be taken from fixed lines may be reliable, he should give the weight of the platen, angle and dimensions of vees, weight of work being operated on. He should say whether the 0.725-inch depth of cut was actual depth of cut including the lifting of the platen or whether it was the depth which the tool was set below the top of the cast-iron blocks before the cut was started. He should say whether the same time was taken in compressing the two blocks on which he relies to get at the pressure of the tool so that we may know whether the flow of metals made any difference in the pressure necessary in each case. It would be very interesting if we could know how long a distance the platen traveled after the belt shifter began to act and how much slipping and stretching of belts actually occurs. It would be interesting to know what actual deformations occurred in the bed itself.

After all, Mr. Pratt's article shows one thing; that is, that the American style of planer bed with open vees is not especially adapted to heavy work. Otherwise than this one thing the planer seemed to meet the requirements very well.

Springfield, Mass. ENTROPY.

Mr. Dornbirer's remarks on page 718 on the rigidity test of a planer, give us an idea of the way in which the subject of rigidity in planers appeals to him; and as some questions are asked I will try and answer them.

Relative to the planer spoken of by Dixie, I believe it was presented, not because of its ability to compete with a modern tool, but rather as a tool of historic interest. The statement is made clearly that the tool is used, not for the regular run of work, but as a useful tool on odd jobs of unusual size which must

be done occasionally. I am very sure that a machine-tool firm putting out such a tool at present, would not find a great demand for its product, since it would not be rigid enough to take the cuts necessary in present-day machine-shop operations. It was a satisfactory tool in its day, however; there was a time when it was called a modern machine. The tool which we call modern at present is much more rigid, yet it is made of the same material as a whole; namely, cast iron. Now, as this modern machine was developed, we did not find designers seeking a different *material* from cast iron, but rather a better *disposition* of the materials at hand; the change was a gradual one, and at present we have a very efficient tool, compared to the one presented by Dixie. But are we to be satisfied where we are, or are we to advance? Every designer is constantly trying to produce a better tool if he is uptodate, and this answers the question just put. If we are to advance, it will be well to know something definite about the weaknesses of the modern tool, and this was the purpose of the test. We can get a more rigid machine without a more rigid material than we have at hand at the present time by a better disposition of this material, since what has been done in the past can be continued in the future.

One may say, in objection, that a more rigid tool will make the price too high, but a more rigid tool may not mean, in some cases, any *more* material, but a different method of shop working. Again, a buyer is usually willing to pay for good design, otherwise the tool tested would not be as popular as it is. Still further, the added cost might be very small; a more rigid machine does not necessarily mean a great amount more of stock; a logical design is a claim worth considering by a manufacturer. If we put a certain belt on a machine, for example, we should expect that machine to sustain any cut which the belt will pull, especially if the belt is kept under a reasonable tension.

The springing of a machine tool will not, of necessity, result in disaster in the generally accepted sense of this word, but it may cause the taking of a greater amount of time to get a certain finish than is really necessary, and this means greater cost, a thing which we wish to reduce as much as possible. Now, while we cannot, at present, expect an absolutely rigid tool, using the term rigid in a physical sense, we *can* get a more solid tool than we have at present, which, in its turn will give us lower cost, and a tool with longer life.

It is a very true statement when we say that the *work* will spring, but it will not spring as much if we have a rigid machine as it will if we do it on a machine which springs; both theory and practice prove this statement. I will not attempt a theoretical discussion, but will tell of an instance in shop practice. In a power-plant firm, located in New England, a gridiron steam valve was used on all sizes of engines, ranging from 75 horsepower to 3000 horsepower. These valves were planed on the face, but the scale was left on the back. This firm had on its planer floor an old chain-drive planer, very similar to the one described by Dixie, and several more modern tools. These valves were planed on the best tool on the floor. The cut, even on the largest sizes, was not much over ¼ inch in depth, and the chain drive would have carried the cut, but it left the surface full of small chatter marks, which the more modern tool eliminated. Of course, the cost of scraping was considerably reduced. Still even this tool did not give as good a surface as I believe a more rigid tool would have given, and it invariably left the valves "sprung" to a small extent, so they would not lie flat on a surface plate. This latter fault was due, in part, to the removal of scale from one surface only.

As to the errors in setting, and poor judgment in treating castings, being a greater cause of difficulty than machine spring, I believe that such are more *apparent* causes, but not more common; since we may lay a certain undesirable effect in a planing job to the clamping, when we cannot readily assign any other cause. Such was the case with the valves mentioned above; several ways of holding were tried, but no better results were obtained until they were run on a rigid machine. This is not saying that care and skill are not necessary in the handling of castings; the valves mentioned were always planed by the best planer hand the firm had, but he could get the best results on the most rigid machine.

Relative to the vibration of the wires, I will say that no vibration or deflection of any sort was considered which was less than 0.00025 inch; whether or not the instruments gave a reading due to sound vibration has not been considered. The instruments *did* give a reading indicating a deflection of practically the same amount for each cut, and this was the information which we were seeking. A study of the arrangement of the apparatus will show that such vibration was due to the cut.

Concerning the springing of the cutting tool, I presume it did spring, but I was not considering it. The aim was not to find *every* place of deflection, but rather to find *some* of them, believing that if the positions of the instruments showed deflection, there was good reason for a systematic study of tool design, by means of experiments.

Considering the density of the lugs, all were cut from the same bar; this bar was cast in a green sand mold and poured from one heat. Two cylinders were compressed in the planer and two in the testing machine; the two compressed under cut were of the same length within 0.00025 inch; of the two put in the testing machine, one assumed a length of 0.725 inch under a load of 4100 pounds and the other assumed the same length under a load of 4300 pounds. In my calculations I assumed an average of these two loads as the stress produced by the cut.

Concerning the oil film on the bull-wheel shaft, a study of the detail of the design in page 758 shows no call for oil in the frame bearing, as the shaft is "set screwed" in at this point. I believe there was a surface compression between the shaft and internal box surface.

The use of a flat-top tool for testing the upward spring of the cross-rail would not have been commercial; a flat-top tool is not properly used at the present time for any other purpose than parting, and I wished to maintain commercial conditions and find the effect of such conditions on certain parts of the machine.

New York City. JAMES A. PRATT.

Alinement of Turret Lathes

Mr. Tempest, on page 571, has something to say on the subject of turret alining to which I would like to offer a suggestion. The turret builders mentioned are evidently trying to machine a turret so that, upon assembling, the holes will line up with the spindle. A method which is followed by a good many of the American turret-lathe builders is as follows:

The turrets are put through in lots, the holes being simply drilled in a jig about 1/32 inch under size and no time is wasted laying out these holes accurately, as it is a very costly operation to make a turret with five or six holes which will all line up accurately with the spindle when assembled. The turrets, when completed, are mounted on the assembled machines and stamped with the number of that machine. A boring tool is placed in the chuck of the machine and one by one the holes in the turret are indexed and bored to the correct size in two operations, roughing and finishing.

There is no chance for error with this method, as each hole is bored in the position and under the same conditions as it will be in use. The question will probably arise from a good many, How about interchangeability? Well! Who wants to change a turret from one machine to another? In the case of a new turret being ordered to replace an old one it would be sent out with the holes small to be bored by the purchaser. Usually by the time a new turret is needed on a turret lathe it is time the machine was sold and replaced by a more modern one. A question which I should like to bring up is why could not the turret-lathe manufacturers get together and agree on a standard size for the holes in the turret for a given size machine. This question is one of importance to any shop using turret lathes to any extent.

It is advisable for a given size of machine to buy all of one make, but when a new turret lathe comes out of that same size built by another concern, which embodies some improvements tending toward greater production a manufacturer naturally wants some of that make. Now what a saving it would be if his various holders would fit this new machine. How often the super calls up the turret department; "Say, Bill, when are you going to get Order No. 1260 out?" And Bill answers; "Well, you see the turrets that that job goes in are all full of other rush jobs and the tools won't fit my other turrets and the tool room hasn't got the new tools done yet." Then the super calls up the tool room and there is something doing there.

Some manufacturers bore the holes in each size of turret to a standard size, but that usually involves making new locking screws and bushings and is quite costly. This question of standard size holes in turrets ought to go along with those old landmarks of standard size and threads for spindle noses and standard taper holes in head and tail spindles. The one who finally brings these three improvements about would deserve a niche in the Hall of Fame.

PAUL W. ABBOTT.

Wilkes-Barre, Penn.

Drawing a Difficult Shell in a Single-acting Press

The article on drawing shells by M. L. Marston, on page 536, interested me, because I have done a lot of similar work. The illustrations and description herewith show a drawing die, with some novel features, which I made recently.

Fig. 1 shows the five operations required on a single-acting press to produce the finished shell, shown in Fig. 2.

Operation 1 shows the blanking and drawing die which works exactly as Mr. Marston's, with the exception that I always knock my shells out with a kicker that passes through the back of the press and rests on the top of the stripper *B*. I show the die in part cross-section and the punch in cross-section to show my little knock-off pin which disappears during the operation and which pushes the shell away from the stripper to which it is held by suction. An enlarged view of the pin is shown at *A*. The punch has a thread cut on it to screw into a plate ½ inch thick, which bolts to the ram of the press and takes all the pull and strain off the set screw. The blank from this die is shown at *C*. The second-operation die is shown in part cross-section, and is held in a cast-iron shoe, not shown. A cap bored to take the shell *C*, is threaded and screwed into the shoe. It locates the die and holds it. It bears on the 45-degree angle *X* of the die. The draw from this operation is shown at *D*. This punch also screws into the same plate as the previous punch. In operation 3 the punch only is partly shown, but it and the die are made in the same manner as the previous punch. In operation 3 the punch is chamfered to give the shell a start in the die for the fourth operation. The shell from the third operation is shown at *E*, and *F* is a bottom view of it. The fourth operation produces the shell marked *G*, and *H* is a bottom view of it. The reason of the chamfer is plain as the

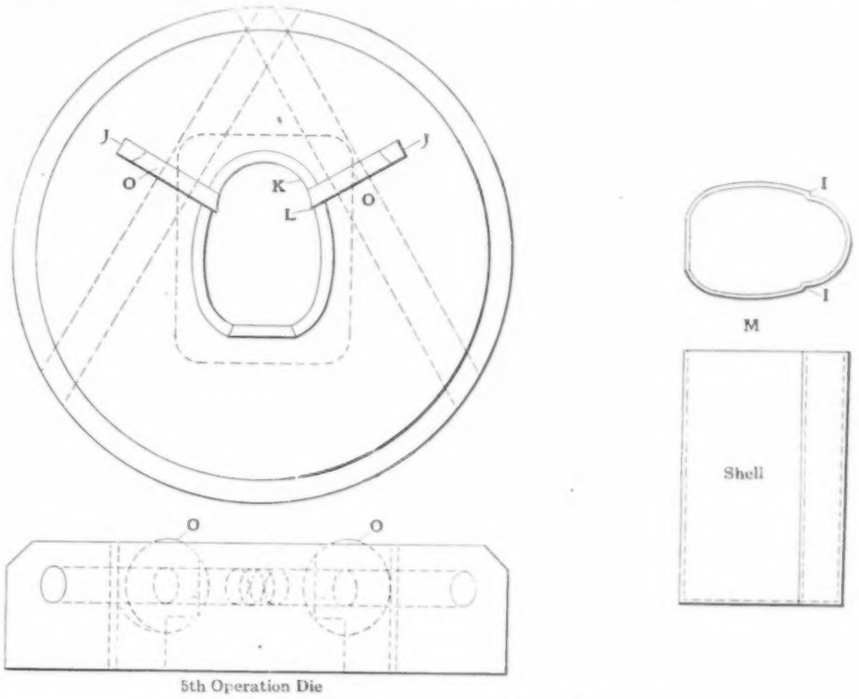


FIG. 2. THE TWISTED SHELL AND LAST OPERATION DIE

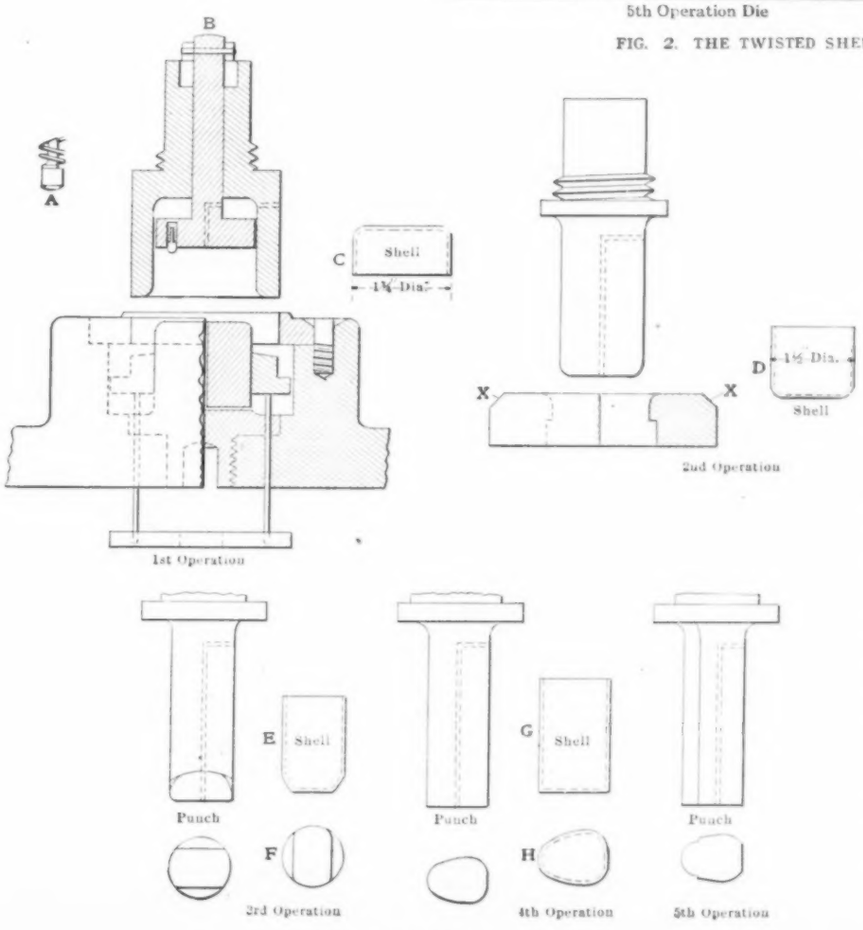


FIG. 1. THE OPERATIONS IN SEQUENCE

corners on the shell now require to come as sharp as possible, and if it had not been made that way in the third operation the fourth would have made a bad mark about ¼ inch up the shell, which would have required a lot of polishing to get out. The fifth and final operation is now to be done. The punch is made to the exact size and shape (shown reduced in size in operation 5, Fig. 1). The die is shown large in Fig. 2, as it requires explaining. I first made this die to suit the punch, but found that the recesses marked *I* in the shell tore and scratched badly. I then slotted out the die at *J*, one face of each slot coming out at the sharp point in the die. The slot was made about 3/16 inch wide. Then I made a pair of rollers *O* and finished out the part of the die marked *K*.

The edges of the rollers were slightly rounded at *L* to avoid breaking and to make *I* the shape required. I drilled holes at right angles to the slots for pins for the rollers to rotate on, and in a position to bring the edges of each roller just a trifle lower than the edge of the die. When the shell from the fourth operation was placed in the die it started to draw the body first, and just as soon as that started it struck the rollers, which rolled the recesses in. This left the recesses smooth just like the body of the shell, and it required very little buffing to finish them.

These operations were all done in a single-action press. The finished shell is shown at *M*; it is 1 15/16 inches long by 1¼ inches one way and ⅞ inch the other, and is made of sheet steel 0.045 inch thick.

Hamilton, Ont. D. B.

Keyway Cutters

Referring to the article by Mr. Brooke, on page 535 it seems strange that instead of cutting open-ended keyways with cutters of the end-mill type he didn't try an ordinary circular mill of correct width to

FIG. 1 FIG. 2 FIG. 3

END MILL FOR KEYWAYS

cut the keyway, and use the end mill merely to take out the stock left at the end of keyway.

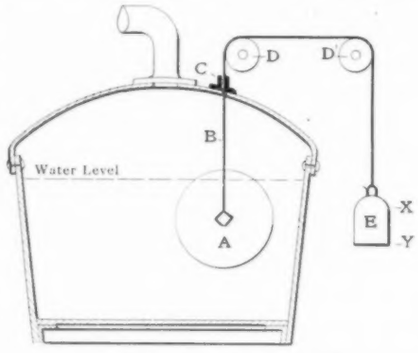
With regard to the flat keyway cutter or cotter mill, the main point is to give it a center cut, as at *A*, Fig. 1, so that after running in to the depth required, the tit of metal left is cut away instead of rubbed off, when the feed is started sideways.

This style of cutter will give excellent results if correctly made and handled, but it is not intended for taking out all the stock at one cut, rather to be run at high speeds with light cuts. When pressed too much a misshapen, inaccurate job is sure to result.

Berkeley, Cal. W. L. WEBSTER.

An Old Haystack Boiler

The article on the above subject on page 715 interested me greatly. It seems a pity to let these old fellows rust but, of course, it is impossible to preserve all of them. The method of running the vertical seams straight instead of staggering



A FLOAT STONE WATER GAGE

each tier seems to me to be wrong. At the bottom of the middle column on page 715 Mr. Maplethorpe says:

"I do not see any sign of gage cocks or water gage."

It is peculiar, for the only part of the half-tone which stands out by itself is probably all that is left, *outside* the boiler, of the water gage.

On top of the haystack boiler is an upright which supports a sheave. If this is what I take it to be then it is part of a water gage much used in the early days.

When Puffing Billy was used at Killingworth colliery in England, that is subsequent to 1813, these haystack boilers were used for raising steam for the winding engines. There was as a general thing either a platform or the brickwork built up around the boiler to near the hight of the water level. The engineer with his wooden-soled clogs would ascertain the level of the water by kicking the plate. The sound would tell him whether there was water or steam behind the part of the plate where he was tapping it with his foot. This was much the same as we tap a plastered ceiling or wall to find where the joists or studding are.

A later invention in the way of a water gage was evidently used on the haystack boiler shown on page 715. It consisted of a piece of stone somewhat like a grindstone. Grindstones when worn small were often used for this purpose. These were called "float stones" and their application is shown in the accompanying cut.

A is the float stone, *B* is a copper wire, one end of which is secured to the float stone and the other end to the iron weight *E*. The wire passes up through the stuffing box *C* and over the two sheaves *D* D_1, *D* being the sheave shown in the half-tone on page 715. As the water "boiled down" the heavy float stone would lift the weight *E*. The relation of the weight *E* to the marks *X Y* showed the engineer where his water was.

If Mr. Maplethorpe will crawl inside that old boiler he will probably find an old float stone.

It is merely a question of specific gravity. In air the stone weighed more than the iron weight *E* but with the stone partly immersed in water the stone would balance the weight *E* in air.

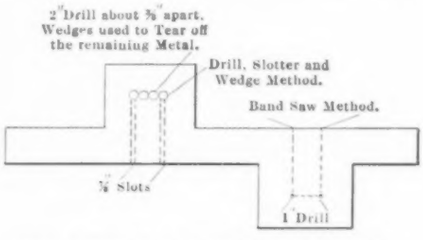
New York, E. A. DIXIE.

The Band-saw as a Machine Tool

The two articles published recently—by Phillip Bellows, at page 543, and Ethan Viall, at page 684—have not quite exhausted the band-saw subject.

An old notebook of mine contains a description of the Westinghouse Machine Company's method of multiple crank-shaft production. On first seeing their drilling, slotting and wedging operations, which preceded the turning, I was much impressed with the heavy work done in what seemed like a short time. But the users of a band saw for this same purpose reduce the cost to less than one-half that of the other operation (see the illustration).

In the shops of Bellis & Morcom, Birmingham, England, I saw one man attending to two or more band saws that were doing the same work on very similar crank shafts; the only drilling necessary was about a 1-inch hole at the internal angle between cheek and crank pin. These forgings were about 9 inches thick; a lubricant something like soda water was used freely. It is true that the feed was slow,


2" Drill about ⅜" apart. Wedges used to Tear off the remaining Metal.
Drill, Slotter and Wedge Method.
Band Saw Method.
⅜ Slots
1" Drill

TWO METHODS OF ROUGHING OUT CRANK SHAFTS

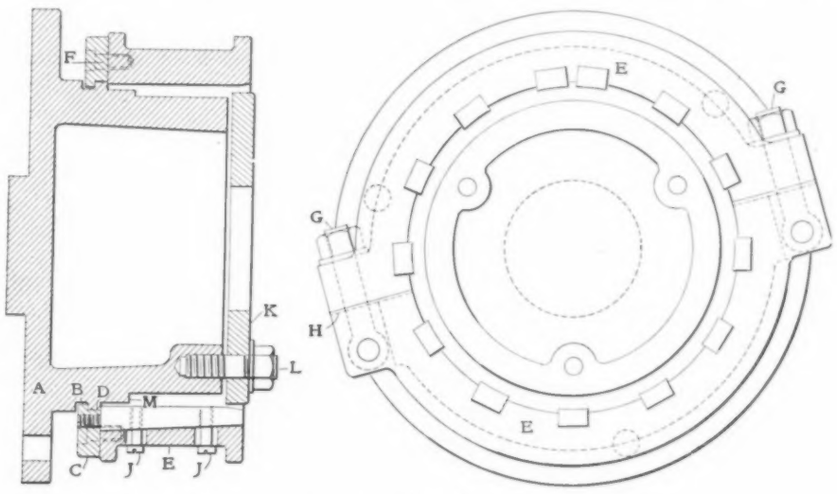
but as one man attended to more than one saw the speed per man was really good. The cost of the machinery was nothing like as great as in the case of the Westinghouse work, where a very large slotter was used to cut the two sides of the waste piece at one operation, and a large drill was used to drill the holes. It was possible to drill but one hole at a time on one crank shaft; though I believe that when more than one shaft was operated on at a time one workman attended more than one drill spindle.

Morton Park, Ill. WM. S. ROWELL.

A Piston Ring Turning Jig

When I read the article by Mr. Osborne, on page 723, Part 1, Vol. 31, the thought came, why not make a jig that would come as near as possible to fulfilling the conditions there presented of the theoretical piston ring.

One of the rings which we have to make fits a 10-inch cylinder, and is first turned 11/32 of an inch large. It is then taken to the milling machine and is milled out square across 9/16 inch long. For the final turning it is put in the jig which is described below and turned exactly 10 inches. Each one is tested after being turned in a hardened and ground ring, and we have found that nearly perfect rings were the result. It took several trials to adjust the rig before we got a true ring, but we finally got a ring which will pass any ordinary inspection. So perhaps the readers would like to know the construction of the jig.



A PISTON RING TURNING JIG

The jig is made with the body *A* so that the boss on the back will fit in the hole of a chuck of a lathe or boring mill. This body has a groove *B* turned a little smaller than the ring *C* which ring fits exactly the tongue *D* next to the groove. The ring *C* is split and each half is bolted and doweled to the halves of the split clamp *E* with screws *F*. The split ring and clamp are first bored and faced up true separately, but are bolted together eccentrically, the amount of the throw being equal to the eccentricity of the finished ring.

Around the inside of clamp *E* are milled or shaped slots similar to keyways, as shown from the front view. The bottom of each keyway is machined on an angle of about 2 or 3 degrees, so that by adjusting the key endwise the radius of the bore of each key may be increased or decreased, depending upon whether the key is moved in or out. At the top of the clamp are placed two keys close together and a pointer or line put between them so that the operator will always get the split ends of the piston rings between these two keys.

The keys after being drawn down to a seat by the screws *J* are bored out true with clamp *E* to the size of the ring after it is turned and split and sprung together. Then they are adjusted by the tool-room man by experiment before it is sent out to the operator.

The ends of the clamps *E* are held together with two eyebolts *G* and are prevented from shifting endwise by tongue and groove *H*. The ring *C* centering on the tongue *D* brings each half to a common center.

When the operator is ready to turn the piston rings, he bolts the jig to the lathe, taking care to see that the boss or plug on the back of the jig fits the chuck properly. Then he puts the split clamp in place and tightens the screws *G*.

Now as the clamp *E* and ring *C* are not concentric to each other, and the ring *C* fits the tongue *D*, then the clamp *E* must be eccentric to the center of the lathe.

Now the operator springs the rings, which have been turned from a cylinder to a certain definite size and split, and also ground on face or sides so they are parallel, into these clamps, taking care to see that the ends of the ring are exactly between the two close keys at the top. This holds each ring in place until the jig is filled up and then the rings are clamped with the plate *K* (not shown in end view) by the screws *L*. Now the clamp and ring *E* and *C* are removed by loosening the nuts on the screws *G* and swinging the screws out. This leaves the piston rings in a position to be turned, being held between the clamp *K* and shoulder *M* on the plate *A*.

The rings do not touch the jig at any other points, but the friction is sufficient on these surfaces to drive for a light cut such as is necessary to remove the balance of the stock.

Perhaps at first one would think that it would be better to center the rings on the inside, but if you will refer to Osborne's article you will see that the inside of the ring is not a true circle. And although not impossible to do so, it would be impracticable.

The jig was made to turn six rings at a time, but I think it could perhaps have been made to turn eight, or perhaps ten rings. However, if the jig is made too long, unless it is extra heavy, there will be spring in it.

Some may say that it could be supported by the tailstock of the turret, but any machine after it has seen one year of good, hard service, is not in perfect alinement. This may seem like a pretty broad assertion, but I think that 90 per cent. of the turret-lathe operators will bear me out in this. Therefore, if perfect rings are required, care should be taken not to turn too many at a single setting.

This jig has given us good satisfaction, and the inspector has had practically no rings to throw out since the jig was correctly adjusted. But we had to turn up five or six settings before we did get the correct adjustment. We make these rings in lots of a thousand, so that you can see we needed something to turn them rapidly as well as accurately, and this was the result.

Charles City, Iowa. E. M. WILLSON.

Should Not Technical-school Shop Courses be Reversed?

As I have had nine years' experience as an engineer and teacher I desire to reply to Mr. Harris's letter in regard to reversing the order of shop courses in technical colleges. Theoretically, I agree with him; one objection, however, is the ease with which a nervous freshman can seriously damage, if not spoil an expensive machine, if he took the machine-shop work first; while as it is now arranged he is gaining confidence in himself without endangering much but his fingers.

In regard to visiting industrial establishments and lecture courses: Many would be unable to understand the latter or derive much benefit from the former as they are unacquainted with the common shop terms and methods of manufacture. The manual-training high schools are giving sufficient knowledge to enable a student to appreciate the visits and understand the lecturer, and as many students entering college are graduates of these schools it is possible that in time such a preparation will be required of all. Then the shop courses could be replaced, partly at least, by illustrated lectures showing commercial methods of manufacture which it is impossible to show in any other way to good advantage.

Chicago, Ill. H. C. GIVENS.

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The Way of the Inventor is Hard

In other columns we print the first of several articles on Salient Points for Inventors. These are written from a wide experience in patent examining and patent soliciting, setting forth the important points and steps that an inventor should follow to protect him in his creative work. We are glad to call attention to these articles, for they are worthy of careful consideration on the part of those who are developing inventions.

At the same time the path of the inventor is so beset with difficulties that it is wise to point out some of them, although the subject has been treated so often that it is worn threadbare.

A few months ago the daily press heralded the fact that patent No. 900,000 had been issued. Patent No. 1 of this series was issued on July 28, 1836. Surely a tremendous record! How valuable it would be if we could know how many of these paid their own cost to their originators: their cost in time, in energy, in money? The smallness of the percentage of such a number to the total, could we but know it, would be startling. It is impossible to make even a wild guess, but anyone who has studied the subject, or personally "played the game" knows that the number of patents that see their inventors out whole is pitiably small.

The reasons for this condition are many. Some deluded inventors—only a few, perhaps—work on problems that are impossible, as perpetual motion. We know one poor individual who has worked on perpetual-motion machines for 15 years, spent some $26,000, and built some 60 models. He imagines that mechanical advantage can produce a larger amount of power from a smaller one through proper mechanism. Other inventors—in this class are many—work on devices that may accomplish what they desire, but the end is foolish. To illustrate: A device to lower a latch key from an upper window at a certain time for the convenience of the morning milkman was actually patented. Others develop improvements on outgrown arts. Such would be an improved tinder box today, when 1000 matches can be bought for a nickel. Others may work out devices or processes that have no market and thus no commercial value, and a much smaller class of inventors are ahead of their times and work out inventions that some time society will use, but not during the life of the patent. How often does a patent search reveal the work of some man, done years before, that discloses the principles of a recent development that it is desired to patent?

We have no patience, and, in fact, we have little else than contempt for the gospel which is preached by so many that invention is the royal road to fortune. There are few more disheartening experiences than the efforts of the average inventor without means to enlist others in financially backing his invention. The occasional and even brilliant exceptions to the rule do not alter the fact that the patenting of even meritorious inventions by those who have no means to exploit them usually represents wasted effort and money of which the bare cost of the patent is frequently the smallest item.

We should not have the publication of these articles taken as in any sense an encouragement to our readers to embark on the troubled sea of the inventor. We simply recognize the fact that there are those who are so situated as to make invention a necessary part of their work, as there are others who will persist in inventing regardless of any advice to the contrary, and the procedure necessary to protect one's rights forms a legitimate and useful field in which to give information, and it is from this standpoint alone that these articles, which we regard as excellent in themselves, are published in our columns.

M. A. Master of Aeronautics

It seems probable that in the near future instead of associating the expression "Master of Arts" with the letters "M. A." after a man's name we will be able to translate these letters as "Master of Aëronautics." The first university course in aëronautics has been established in America, and is the latest addition to the curriculum of Columbia University. One student has been enrolled and his position refutes the common statement that individual work is lacking in our great universities, for it is evident that he will have the faculty of aëro navigation all to himself. We understand that the first half of his year's work will be on the historical side of the subject and the latter half devoted to experimental investigation by means of airship models.

This experimenting with models is an interesting phase of the scheme of study, for naturally it is directly in line with the methods pursued in beginning engineering education in all of the now well established schools. As time went on these models were superseded by commercial apparatus. We may expect, therefore, that in a few years courses in aëronautical engineering will have at their command commercial balloons, dirigibles, aëroplanes, and the like. When that time has arrived we may look for a rush on the part of students into the courses of aëro navigation. Experimental flights in an airship surely sound more attractive than sweating over a boiler test, or taking an engine's speed at 2 o'clock in the morning, or standing for several hours beside a group of steaming, foaming water-rheostat barrels. What a zest would be given to experiments that were really attempts to break records made by members of former

classes! We are sure that efforts of that kind would appeal to the undergraduate's mind as being well worth while, or at least would arouse a far different attitude from the one that would be adapted toward an opportunity to run an engine test that should show a steam consumption one pound better than obtained by the class of last year, or to show that a particular manipulation of a generator gave one per cent. more efficiency than it ever did before, or perhaps to investigate the value of *g* and find that it was somewhat greater or less than the usually accepted value. We fear that records of this latter kind do not appeal to the student, and for the very good reason that he knows that probably the methods of experimentation and results of his predecessors are of no more value than his own.

At one time we experimented for several weeks with an Atwood machine in order to determine the value of the increment of gravity. After a long series of conscientionsly conducted experiments and computations, we arrived at the astounding result that the value of *g* was not only very much less than the accepted value but, alas, was negative! For several days we walked around in an apprehensive frame of mind, wondering what would happen if the animate and inanimate objects around us knew the results of our discovery, and should suddenly appreciate that the invisible bonds of gravity had been loosened and that Mother Earth even showed a tendency to exert a thrust rather than a pull.

But to return; the opportunity of making a longer flight with aëreplane No. 1 than the record established by Jim Smith last year, or reaching a higher altitude with dirigible No. 0, than Bill Jones' record of two years ago, or establishing a record for the longest flight with one gallon of gasolene; indeed! these are opportunities that should attract the undergraduate engineer. When this time arrives prudent parents may think it wise to generously insure the lives of their sons just before they reach the experimental stage of their course.

A field for the philanthropist and public-spirited man of wealth is also opened up in the forthcoming need of aëronautical apparatus. Experiments such as we have hinted at would require a considerable area of ground to conduct them properly, and it is surely in order for our engineering colleges to expect gifts of a square mile or so of vacant land to be known as, the So-and-So aëronautical experiment station, or the So-and-So aëronautical field, or the aëronautical laboratories of such-and-such an institution.

But, dropping any spirit of levity, we are glad to welcome this latest comer among the engineering courses of America. The lone student at Columbia is but the leader of numbers that will follow in his footsteps, and we may look back upon the present time as the beginning of that intelligent scientific study of the problems of aëro navigation that shall bear practical fruit.

Monthly Meeting of the A. S. M. E.

The next monthly meeting of The American Society of Mechanical Engineers will be held in the Engineering Societies Building on Tuesday evening, January 12. The paper will be by Carl G. Barth, of Philadelphia, upon the Transmission of Power by Leather Belting, illustrated by lantern slides. It will be a comprehensive summing up of the theory and practice of belting in which conclusions are drawn from the work of Lewis, Bancroft, Bird and others, who have made experiments upon the transmission of power by belting. Valuable charts have been prepared by the author for the solution of belting problems.

Mr. Barth's long experience in the scientific running of machine tools, in connection with the introduction of improved shop methods, has shown the need of definite data for the application of belting to machinery and led to the development of the results contained in his paper. His data have been applied to belting in different plants for many years, giving an unusual opportunity to study the problem in great detail.

New Publications

MACHINE SHOP CALCULATIONS. By Fred. H. Colvin. 174 4½x6¾-inch pages; numerous illustrations; indexed. Hill Publishing Company, New York. Price, $1, postpaid.

In this book the author has covered the field of this former well known book, "Machine Shop Arithmetic," in a broader, enlarged and more comprehensive manner. Machine-shop calculations are a distinct branch of mathematics as far as their application is concerned. This feature has been prominently developed throughout the work. All of the examples are expressed in shop terms, units and quantities. They have the quality of practicality, a quality that is too often lacking in made-up examples in arithmetic. The 20 chapters of the book can be divided into two classes: general shop arithmetic and special machine-shop calculations; the latter, of course, is dependent directly upon the former. In the first class are common and decimal fractions, cancellation, ratio or proportion, percentage, square and cube roots, measuring surfaces and volumes, measuring angles, making and using formulas, proportions of regular polygons and shop trigonometry. In the second class are grouped speed of pulleys and gearing, gearing a lathe to cut any thread, screw-thread calculations, drilling for taps, taper work, speed of lathes, planers and shapers, and the vernier and micrometer. In the first group the treatment of cancellation, percentage, contents of solid bodies and making and using formulas are especially worthy of comment. Cancellation is one of the most useful of arithmetical processes, and it is illustrated and described so that anyone can understand the principles and apply them. Percentage is illustrated as applied to a man's pay, through a certain per cent. of increase or decrease —a treatment that will appeal to everyone. Volumes of solids are worked out from the general prismoidal formula, but in a clear, nontechnical manner. The making and use of formulas is one of the happiest treatments of this subject that we have ever seen. It likens an equation to a fraction with its numerator, denominator, and, when solved, its quotient. Thus, the principles of common fractions that have been laid down earlier in the book are directly applied to equations, putting the subject in a most clear form. The group of special machine-shop calculations needs no detailed mention, for every man in the shop knows its value. However, the chapter on gearing a lathe to cut any thread is as complete a treatment of this subject as has ever appeared in the space of a few pages. The book is in no sense a handbook, but lives up to its title in that it presents the principles of machine-shop figuring and calculations. The style in which it is written is especially worthy of commendation, for it is nontechnical, clear, concise and shoppy, and, therefore, in language that can be readily understood by a person whose advantages of education have been limited. In its field it should prove of great value, and we take pleasure in recommending it.

George M. Laughlin

George M. Laughlin, for many years head of the Jones & Laughlin Steel Company, a son of the founder of this well known firm, died at his home in Pittsburg on December 11, having passed his sixty-sixth birthday.

Major Laughlin, his military title being as a result of his participation in the Civil war, entered the firm of Jones & Laughlin at the close of the rebellion, and from then until 1900 he was actively engaged with its affairs, serving in many capacities, and upon the death of the firm's founders was its practical head. He has been an important figure in the iron and steel industry for many years. During recent years his interests became many, as since 1900, at which time he was made vice-chairman of the board of directors, he was not actively engaged in the steel industry.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make It Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

Universal Micrometer and Surface Gage

The accompanying illustrations show the universal micrometer and surface gage in various positions. Fig. 1 shows the bar of the micrometer held in the base clamp to be used as a bench instrument. In this position any measurement up to 7 inches can be taken. The bar can be shifted endwise to any desired position in the base clamp, and by a quarter turn backward the instrument can be lifted out of the clamp and placed in position to permit the sliding head to be moved to the desired unit on the bar as indicated by the figures. As shown in Fig. 1, the instrument to be used in the hand will measure round work to 4 inches in diameter and flat work 7 inches by thousandths of inches. The bar is flattened on one side as shown, and the inch positions are determined by conical holes in the center of this flat. To set the measuring head to the required position on the bar, it is only necessary to slide the head to an approximate position as indicated by the figures and screw the locating pin down until its end seats itself in the hole in the bar. This operation positions the head accurately on the bar and clamps it rigidly at the same time. The bar as well as the locating pin and the bushing which guides it are hardened, ground and lapped.

FIG. 1. UNIVERSAL MICROMETER SURFACE GAGE

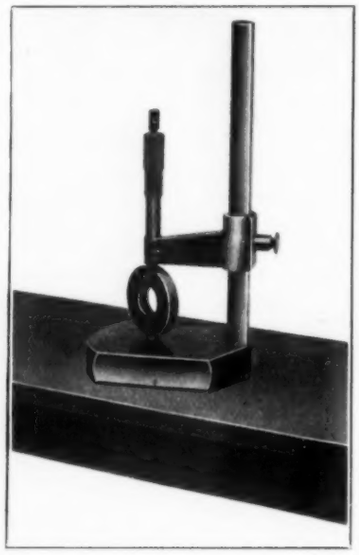


FIG. 2. IN USE VERTICALLY

In Fig. 2 the anvil head has been removed, and the bar and micrometer head are in position over the base anvil with a 2-inch disk between the measuring surfaces. From 0 to 7 inches can be measured in this manner. The distance from the bottom of the base to the anvil is 1 inch. With the head positioned to the second hole of the bar 0 to 1 inch can be measured. The bar is drawn to its seat in the base by the same screw used in connection with the anvil head.

Fig. 3 shows the instrument with the bar given a half turn in the base and the head positioned to the seventh hole in the bar measuring a 6-inch hight block. In this position any distance from 0 to 8 inches can be measured. Cast-iron hight blocks, as illustrated, 6 to 12 inches high can be furnished. With these the instrument has a measuring range of 26 inches by thousandths of inches. They are useful in setting the tables of milling and boring machines to an exact position in relation to the centers of their spindles. Also in measuring the various hights of planed and milled work, the hights of jig bushings, etc. Fig. 4 shows the instrument used as a scribing gage with circular scriber attached to the end of the measuring spindle. This disk is notched on its periphery, as shown; the lower face of the disk is ground at right angles to its bore. The upper side of the disk is ground at a slight angle and to a sharp edge, the points formed by the notches being the scribing elements. The lower side of the disk is drilled and tapped for a screw the head of which projects over the wall of the bore and locates the scribing line in the plane of the end of the measuring spindle. The disk is slotted and clamped to the spindle by means of a binding screw. The face of the disk being flat, no subsequent grindings in the faces of the notches to keep the scribing points sharp will modify its accuracy. Taken in connection with the hight blocks lines may be drawn on work from 1/16 inch of the base surface to the full range of the instrument by thousandths of inches as readily as the same measurement can be taken. It is, of course, understood that the measuring spindle should be locked before the scrib-

FIG. 3. TESTING A HIGHT BLOCK

FIG. 4. LAYING OUT A JIG

ing is done. The jig in Fig. 4 has 41 holes, which were all laid out in 35 minutes, including going over them the second time for verification. This is made by the Schellenbach-Hunt Tool Company, Fourteenth and Plum streets, Cincinnati, Ohio.

A Heavy 36-inch Lathe

This is supposed to be the largest lathe of this type that has ever gone out of Cincinnati, being built by the American Tool Works Company of that city. It has a 36-inch swing, automatically throws out back gears when the pinion slips into or out of internal gear, has friction to carriage with a saw-tooth clutch on the cross feed. The feed box in front of the lathe gives three changes for every change of gears on quadrant; gears are inclosed whenever possible and loose gears are bronze-bushed.

A turret with an extra long slide is supplied for special work, a novel feature being the indexing mechanism which is located at the front of the slide instead of the rear as usual, and brings the locking pin near the cutting tool. The turret can be tripped and revolved either automatically or by hand or can be cut out entirely to run the slide back to its extreme limit without withdrawing the locking pin, this being accomplished by the small lever near the large pilot wheel.

The front of the turret slide is supported by a bracket which bears on the ways and eliminates all tendency to spring even when clear out. This bracket can be removed to allow the slide to pass over the carriage. The whole turret can be moved by small pilot at the rear, through gears meshing into the rack. It is clamped by two eccentrics, one at each end of bed and a pawl is also provided which can be dropped into a rack cast in the center of the lathe bed.

The turret has eight changes of feed, ranging from 0.005 to 0.162 inch and one entirely independent of the regular carriage feeds. These are controlled by the two star-shaped knobs below the headstock, index dials showing the feeds in use. These feeds operate in either direction, which is especially useful in backfacing. Fig. 2 view shows how the feeds are transmitted to the turret slide. The turret slide can also be attached to the compound rest, giving it the carriage feeds, as in large tapping work, giving the taps a positive lead. It is also useful in chasing with a turret tool.

The carriage has a taper attachment of heavy proportions, designed to avoid all binding tendency and having a support on the bed itself. The whole attachment bolts to the carriage and travels with it. It is carefully graduated and has a vernier for fine adjustments.

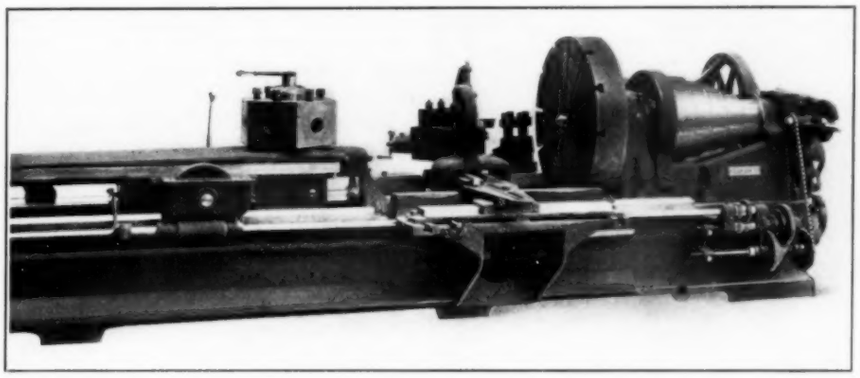
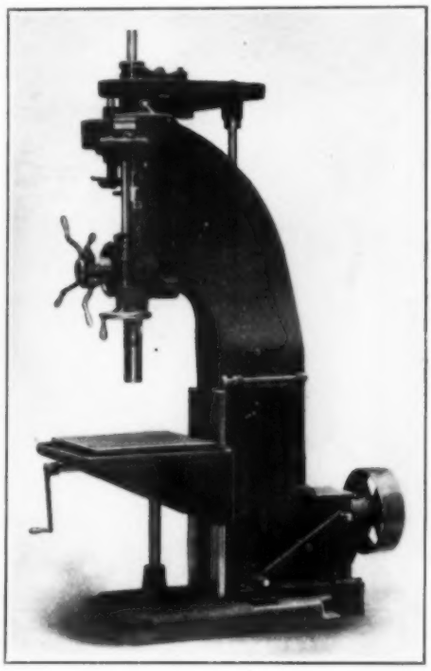


FIG. 2. REAR VIEW SHOWING FEEDS FOR TURRET SLIDES

A High Duty Drill Press

This machine has a capacity for high-speed drills from ½ inch to 1¾ inches diameter in steel to their full cutting capacity. The machine is single-belt driven, and no shifting of belts is required. All speed and feed changes are through quick-change device. Levers for stopping and starting machine, and for changing feeds and speeds, are all within easy reach of the operator at all times. Spur gears are used throughout, except one pair of slow-running 2-to-1 bevel gears at the driving end and one worm and worm gear for the feed.



A HIGH DUTY DRILL PRESS

The spindle is of forged high-carbon steel, fitted with a ball-bearing thrust guaranteed not to crush under the most severe duty.

Three changes of geared feed are provided, any one of which is instantly available by shifting a lever, conveniently

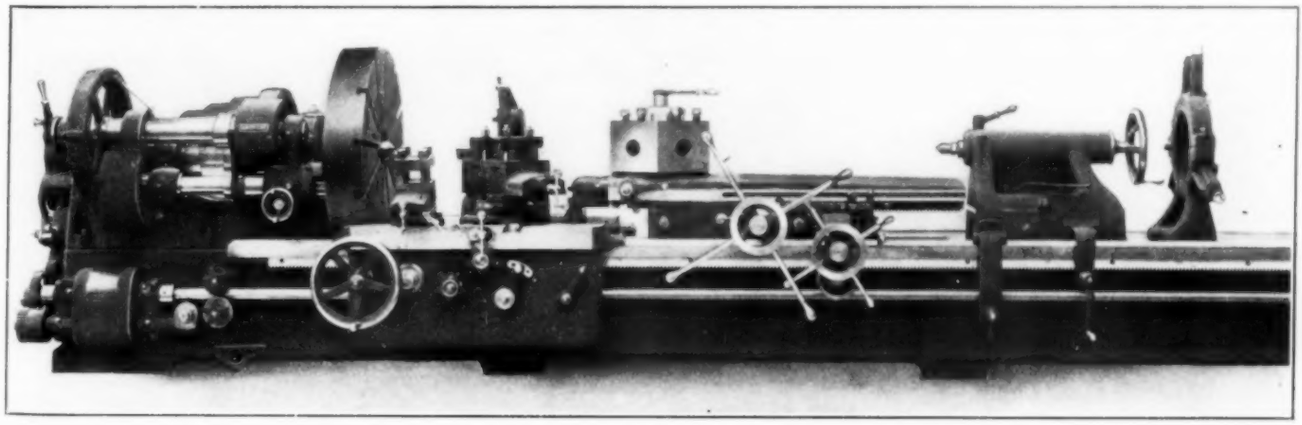


FIG. 1. HEAVY 36-INCH LATHE WITH TURRET AND TAILSTOCK

located at the front of the machine. All feed changes can be made without the necessity of stopping the machine. Power feed is provided with adjustable automatic stop and hand stop. Hand feed is through worm and worm gearing, and quick traverse of spindle in either direction is accomplished through the spider hand wheel, located at the front of the machine.

The table is of the knee type, having a square lock-bearing surface on the upright, to which it is gibbed. It is further supported and elevated by a square-thread screw, located underneath, slightly back of the center of the spindle, to permit boring bars or other tools passing through the table. It is also provided with oil grooves and two T-slots.

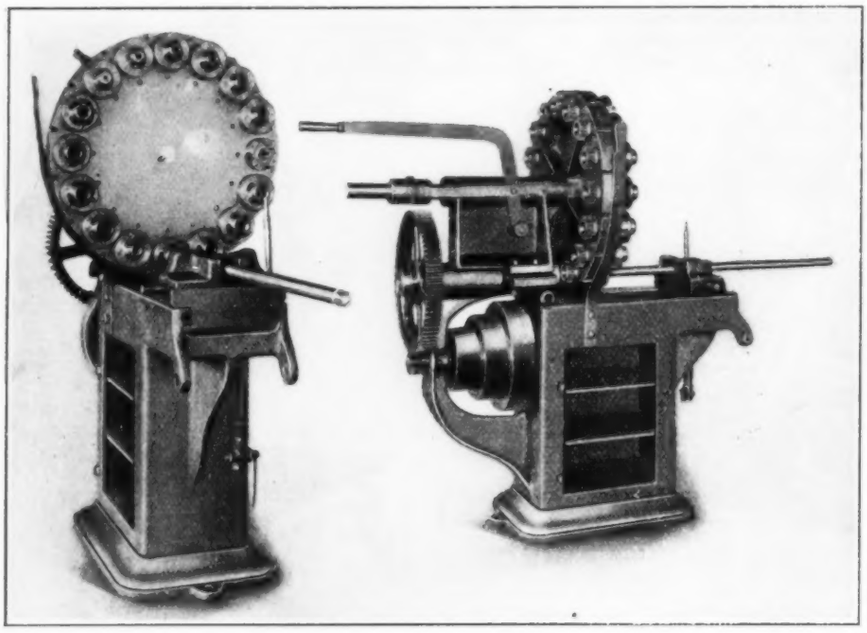
The drive is self-contained, and located in the base of the machine. The nine spindle speeds are through a double train of gearing, which is always in mesh and runs in a bath of oil. This device consists of a lock bolt engaging any one of three gears in each of the two trains, giving the nine speeds from 71 to 306 r.p.m., any one of which is instantly available by shifting the levers, located at the side of the machine, to the different locations for different speeds, as indicated by index furnished.

A tapping attachment can be furnished when so desired which reverses at a ratio of 2 to 1

A compound table, which is an extra attachment, can also be supplied. It has a longitudinal adjustment of 14 inches and a cross-adjustment of 8 inches. The platen is fitted with two T-slots, running lengthwise; also with a liberal oil groove, and has a working surface of 16½x30 inches. When compound table is furnished, the maximum distance from the nose of the spindle to the top of the table is decreased 5¾ inches. This machine is built by the Foote-Burt Company, Cleveland, Ohio.

Bolt Cutter with Multiple Dies

Something of a departure in the bolt-cutter line has been brought out recently by the Alfred Box Company, Philadelphia, Penn., in the way of a vertical turret head or plate for the dies and hollow mills or other tools. A good idea of the machine can be had from the illustration, sixteen tools being distributed as shown.



BOLT CUTTER WITH MULTIPLE DIES

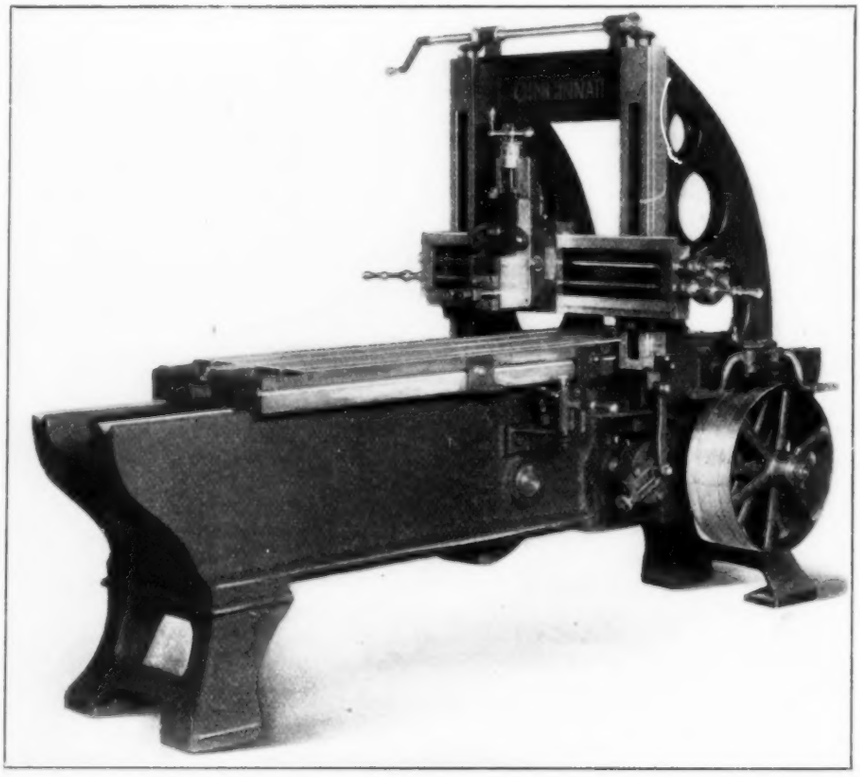
The cone drives the main shaft above through the pinion. This shaft has an internal gear into which the gears on the back of the turret are slipped, forming a clutch for driving the tool in line with the work, all the others remaining stationary.

To change the tools the lever at the top is raised, moving the upper spindle forward through the side levers and taking the gears out of the clutch on the main spindle. The turret stop is then pulled out of the notch, the turret revolved to the proper position and the stop allowed to spring back into place as shown, when it is clutched in by moving the turret. This holds it while the milling tool or die is being driven on the work which is held in the vise shown in front of the turret.

The vise slides in suitable ways under control of the lever shown and can be fed into a hollow mill or started in a die as desired. The bed forms an oil pan which is fitted with a pipe for drawing off when necessary.

A New Small Planer

This is a 22-inch planer recently added to the line of the Cincinnati Planer Company, Cincinnati, Ohio, to meet a demand for a small machine. It is ordinarily made with but one cutting speed, but their two-speed device, recently illustrated, can be attached when desired.



A NEW SMALL PLANER

A new shifting device is used, which has been designed especially for high speeds and short-stroke work. It has a safety locking device, and can be operated from either side of the bed. The crank handles are fixed on the screw, but have revolving handles, so that the operator can retain his hold easily. The swivel is graduated for the full circle so that it can be read from both sides of the machine. The shafts all run in special bushings fitted into the bed and have oil grooves which insure constant lubrication. The planer will handle work 22x22 inches, and is made in 3-, 4- and 5-foot lengths.

Chuck for Drilling Square Holes

The engravings illustrate an attachment by means of which a lathe, drill press or milling machine may be utilized to drill square holes in cast iron, steel, brass or other materials with the same facility that round holes can be bored with an ordinary twist or flat drill. This device is known as the "Radical Angular Drill," and is being introduced into this country by the Radical Angular Drill Company, of 114 Liberty street, New York City.

The apparatus, as shown in Fig. 1, consists of a special drill and a special chuck. The drill for boring square holes is three-cornered, the cutting edges being on the end of the drill, as in the case of twist drills and flat drills. This three-cornered drill is caused to revolve and at the same time to move about in such a manner that it cuts out a square hole, the corners of the drill going accurately into the corners of the square and removing the metal in a clean, uniform manner. The mechanism by which this is accomplished is the special chuck, which, as shown in Fig. 2, consists essentially of three parts; first, a member *A* which is screwed solidly to the spindle of the lathe or milling machine, and revolves with the latter; second, a stationary member *B* which does not revolve, but which is supported from the rotating part by a circular bearing. This stationary part contains the matrix or form which guides the three-cornered tool in its four-cornered course, and the guide is adjustable, as at *C C*, so that it may be used for any sized tool within certain limits. The third member of the chuck is a socket *D* into which the shank of the tool is screwed. This socket is driven around or caused to rotate, by part *A* of the chuck referred to above, but is free to move sideways in all directions to a certain extent. At its rear it has a ball-thrust bearing against the first part of the chuck, which takes the pressure of the tool against the work.

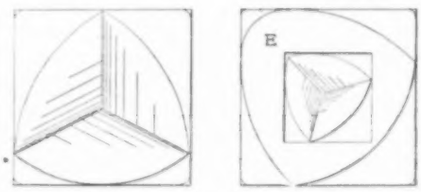


FIG. 3. ACTION OF THREE-CORNERED DRILL

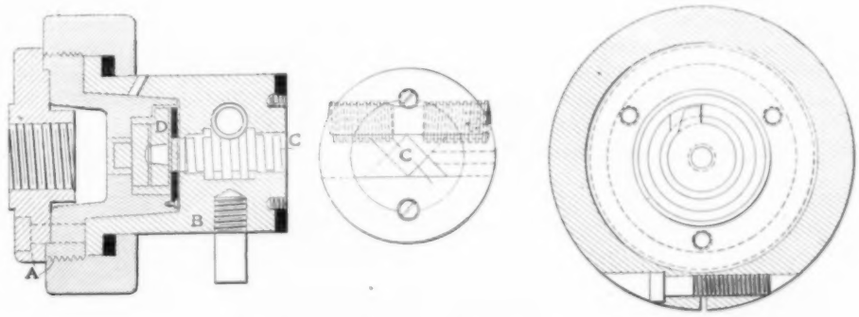


FIG. 2. CHUCK FOR SQUARE-HOLE DRILL

The remaining essential feature of this device is the shape of the shank of the drill itself. This is not triangular in section, but is formed, as in Fig. 3, by the intersection of three equal circles struck from the three corners of an equilateral triangle. The common radius of these circles is just equal to a side of the equilateral triangle and to a side of the square guide formed by part *C* of the chuck; likewise equal to a side of the square hole to be bored. It will thus be seen that as the three-sided drill is turned about in its four-sided guide, the sides will partly roll and partly slide upon the latter. For instance, it will be noticed that as long as one of the arcs of the three-cornered shank is rolling or sliding upon one of the straight sides of the square guide the opposite angle of the shank will move in a straight line.

There is a certain point, however, when the angle of the three-cornered shank approaches one of the corners of the square, where this straight-line motion ceases, and the extreme corners of a square cut by this tool are, therefore, rounded, although the sides are straight up to the point where the round begins. If it is desired to bore holes with sharp, square corners, a special tool is used which differs in two respects from the tool just described. In the first place the shank is considerably larger than the cutting head of the tool, and in the second place, one of the corners of the shank is rounded off to a curve, as at *E*, Fig. 3. The result of having the shank of the tool larger than the head and of rounding one of the corners of the shank is that one of the cutting corners of the head enters completely and fully into each of the corners of the square hole that is being bored, producing a hole that is sharp and true.

This device can be used to countersink for square heads of bolts or to drill square holes in keys, wrenches, hand wheels, die holders, etc. While it is readily applied to lathe, drill press or miller, where it is to be much used it can be somewhat simplified by making the secondary or sta-

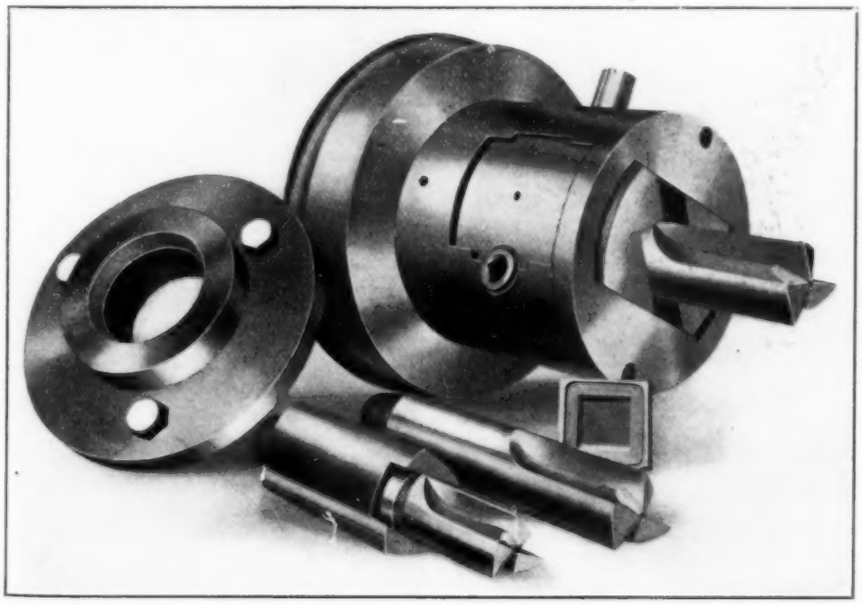


FIG. 1. CHUCK AND DRILLS FOR SQUARE HOLES

tionary part of the chuck an integral part of the machine. By using suitable guides and drills, triangular, pentagonal, hexagonal and other holes can be cut, as well as square holes. The drills are shaped by using a simple attachment on an ordinary grinding machine.

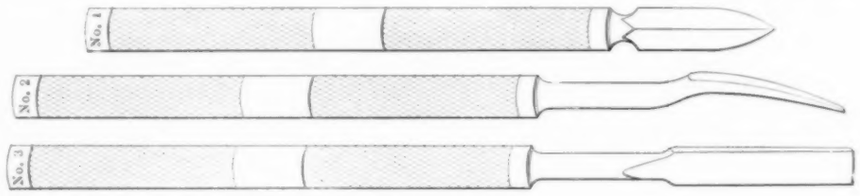
Motor-driven Tube Cutter

In order to make this pipe cutter available in any location, regardless of line shafting, it has been equipped with Westinghouse alternating current motor of 3 horsepower. Power is transmitted through a Morse silent chain and a series of gears, driving the disk cutter which is supported in the cut by the large rollers above. The length of pipe cut off is regulated by the stop on the rectangular bar and the pipe being cut revolves on the lower rollers, being raised into contact with the cutter by the lever shown or it can be raised by the wheel and screw shown.

This will handle boiler flues equally well and cuts a 4-inch flue in eight seconds or a 1½ inch wrought-iron pipe in three seconds. Two of these were recently sent to a large railroad shop for flue-cutting work. It is made by the Fox Machine Company, Grand Rapids, Mich.

A Set of Toolmakers' Scrapers

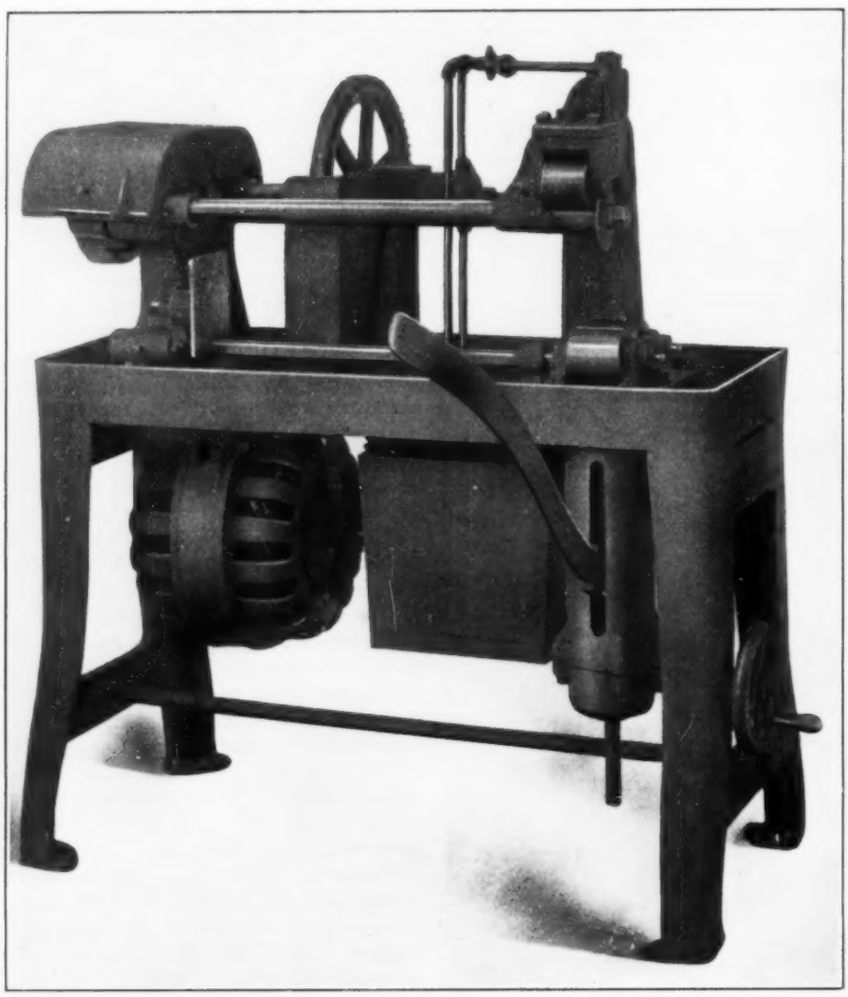
This handy set of scrapers is intended for the use of mechanics who desire something neater and better than the regulation scraper made from an old file. The handles are of steel tubing nurled and the blades of high-grade tool steel tempered, ground and polished. No. 1 is triangular, hollow-ground on all sides and is furnished in two sizes with regular or extra slim point. No. 2 is half round and curved for small bearings, etc. No. 3 is flat for light surface work. The handles are ⅜ inch in diameter. No. 1 is 6 inches long and Nos. 2 and 3, 7¼ inches long. These scrapers are supplied either singly or in sets and are manufactured by J. E. Poorman, 1722 St. Paul street, Philadelphia, Penn.



TOOLMAKERS' SCRAPERS

An Automobile Tool Kit

The Tudor Manufacturing Company, Taunton, Mass., has brought out a new tool kit packed in a handy box for the use of automobilists. Besides a complete set of stamped hexagon and square sockets the kit contains a reversible ratchet which can be moved up or down the shank to any desired point. The shank is in sections so that any desired length up to 18 inches can be obtained. The handle of the ratchet wrench is secured to the



MOTOR-DRIVEN TUBE CUTTER

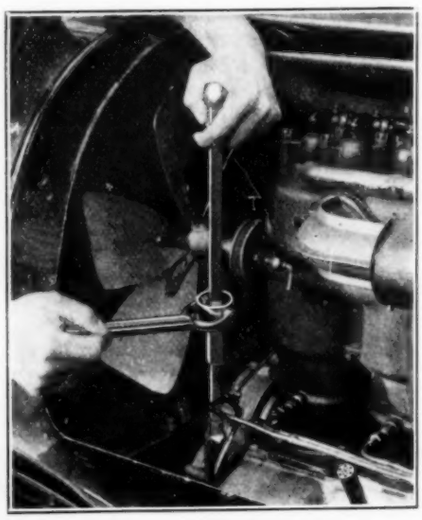


FIG. 1. ADJUSTABLE, QUICK ACTING RATCHET AND SOCKET

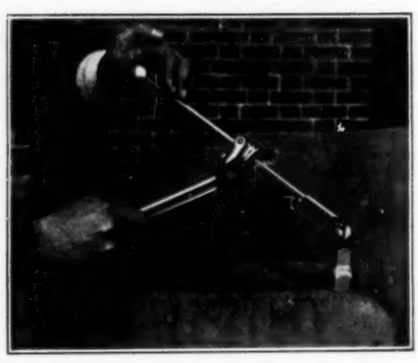


FIG. 2. UNIVERSAL JOINT USED WITH SOCKET

ratchet head by means of a pivoted yoke which permits the handle to lie close to the shank when put away in the box. The outfit comprises 30 sockets to fit any nut on any car, a spark-plug socket, a square-shank screwdriver and a universal joint to permit the tightening of nuts in unhandy places. Fig. 1 shows the ratchet and straight shank and socket in use. Fig. 2 shows the universal joint in use in combination with the ratchet.

The Buckeye Die Stock

The dies used in this stock are of the chaser variety, with a short cutting edge and are easily sharpened and renewed. As soon as they have been threaded to the

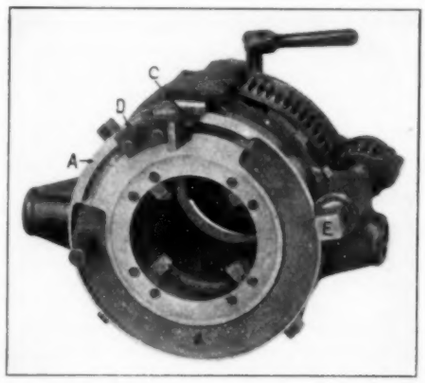


FIG. 1. THE BUCKEYE DIE STOCK

FIG. 2. AS A PIPE CUTTER

pipe a predetermined distance, they stop cutting and release themselves, a cam plate enabling them to be thrown out far enough to clear the work so that no backing off is necessary.

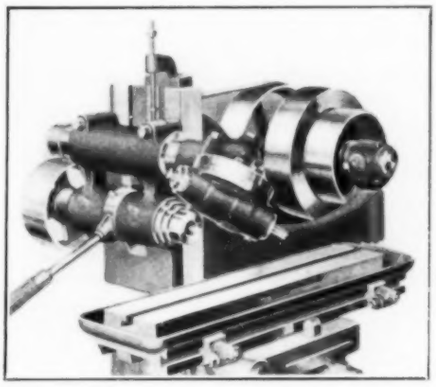
A leader ring takes the place of a lead screw and allows right- or left-hand threads to be cut at will, while not interfering with the dies being removed without backing off.

The die frame is fastened to the pipe to be cut by the clamp screw at the back. Dies are inserted in their proper place. Stop *B* is clamped so that mark on boss *D* shows the size to be threaded, then cam plate *A* is turned until stop *B* strikes the dog *C* which is thrown down. A ratchet wrench *E* is used to turn the stud *E* and turns the die around the pipe which is held in a vise during the operation. Oil holes in the body allow lubricants to be fed to the chasers.

Fig. 2 shows the same head with a pipe-cutting tool holder attached to the cam plate. This also shows that the regular pipe-stock handles can be used when the gearing is not needed. This gives a clean, square cut at a fair speed. The gears permit pipe up to 4 inches to be cut by hand, one set of chasers handles four sizes of pipe. These are made by the Hart Manufacturing Company, Cleveland, O.

A Vertical Universal Milling Attachment

The illustration shows a vertical high-speed universal milling attachment which



A VERTICAL UNIVERSAL MILLING ATTACHMENT

has been applied by the Whitney Manufacturing Company, Hartford, Conn., to its well known hand-milling machine

The spindle, which is driven by gears and belt, as shown in the half-tone, can be swiveled to any angle. The addition of this attachment to the hand-milling machine greatly extends the field of its usefulness.

Personals

Harry Kerr has resigned his position with the Boston Gear Works, and has become connected with the New England Gear Works, of Boston.

Following the resignation, due to ill health of Dr. Wm. H. Wahl, who for many years has been the secretary of the Franklin Institute of Philadelphia, James Christie has been recommended by the board of managers for election as secretary pending the finding of a man who can devote his entire time and attention to the work.

Cooperative Education at Cincinnati

Feeling that it is scarcely possible to give too much publicity to the unquestioned success of the coöperative system of education which is now fairly inaugurated in Cincinnati, we give below a brief report of the discussion of the subject at the quarterly meeting and dinner of the Cincinnati Metal Trades Association, which was held at the Cincinnati Business Men's Club, the evening of December 10.

To us the most striking feature of this movement is the fact that regarding it manufacturers and educators enthusiastically agree—a feature of educational work wherein it is unique.

Among the speakers were two, A. V. Perrson, mechanical engineer of the Solvay Process Company, Syracuse, N. Y., and Edward Robinson, professor of mechanical engineering, at the University of Vermont, who had gone to Cincinnati expressly to study the coöperative plan, the former announcing that on his return to Syracuse his company would start a coöperative school of its own, while the latter gave it as his opinion that this is the only solution of the question of higher engineering education.

Professor J. L. Shearer, of the Ohio Mechanics' Institute, spoke at length concerning the new building which is to be erected through the generosity of Mrs. Thomas J. Emery, and requested the appointment of a committee to confer with him with relation to the construction and equipment of the new institute.

The committee appointed consists of Fred A. Geier, chairman; J. C. Hobart, J. H. Day, Wm. Lodge and S. P. Egan. The last speaker of the evening was Dean Herman Schneider, of the university, the founder of the coöperative course in engineering. He was greeted with a storm of applause and said he found his greatest gratification in the knowledge that the coöperative course in engineering was doing more for the students and the cause of engineering education than had been expected by the most sanguine. He said that he was especially grateful to the members of the Cincinnati Metal Trades Association for the assistance they had given to him and without whose help the coöperative course would have been a failure.

Secretary J. M. Manley read a report, which is in part as follows:

On June 12, a resolution was adopted with relation to this great educational propaganda, emphasizing its importance to our youth, our industries and the community at large and setting forth that in our opinion it is the most important constructive and development work that can be done by the association.

It is admitted not alone in this city, but throughout the entire country, that the industries of this city have entered

upon a new era because they recognize the fact that if the manufacturers of this country are to retain the position they now occupy in the commercial world, it is necessary that prompt and intelligent action be taken, to the end that the intelligence and efficiency of the workman may be increased.

This will be brought about in a large measure through the coöperative course in engineering, which has been established jointly by the University of Cincinnati and the industries of the city.

The great mass of correspondence between this association and manufacturers and educators in other cities attests the interest of all progressive Americans in this important subject.

A coöperative course, patterned after the Cincinnati plan, has been adopted in Chicago, St. Louis, Worcester and Fitchburg, and it is gratifying to note the number and prominence of visitors who come to Cincinnati to study the Cincinnati plan.

The extension of this course to the high schools (to which it is equally adaptable, if within the powers of the board of education) would result in bringing this thoroughly practical training within the reach of a great number of young men who crave for it and increase the attendance as well as the efficiency of the high schools, thus enabling them better to equip their students to meet the demands of society.

Among those who are employing in their factories the coöperative apprentices today, and who know the actual results of such employment, we do not understand that there is any controversy respecting the feasibility and unquestioned value of the coöperative course in engineering. It seems to be undisputed that the coöperative apprentices are actual producers in the factory and that in the university they are doing 25 per cent. more work than regular four-year students.

It has brought to our community a class of sturdy young men whom we are proud to admire and whose success in the future is assured. They learn each day how to apply in a commercial atmosphere the theory they get in the university and become familiar with modern shop practices and learn the meaning of the words, "time" and "production."

The country is aroused on the question of industrial education, and to illustrate the necessity for it we quote from a late communication of Consul-General Mason, of Berlin, which refers to the report of a German commission who were sent here to examine American industrial conditions, as follows:

"They note the enormous disparity between American and European wages, the high rates charged by express companies, and the general heavy cost of handling business in the United States, and conclude that on the whole the American danger has been greatly exaggerated and that a steadfast adherence by Germany to the educational system and commercial methods now in practice will leave the Fatherland little to fear in future competition with American-manufactured goods.

"When it is remembered that this highly educated, efficient and ambitious labor costs the employer only from one-third to one-half the wages that are paid in the United States and that it is comparatively tractable and easily managed, it will be seen that a situation is being developed here which our countrymen will do well to take into account."

With these conditions confronting us, coupled with the knowledge that we in Cincinnati are actually giving young men practical industrial education through the coöperative course in engineering, we may be pardoned for pointing with pride and admiration to our achievement in this great field of usefulness; and while great educators and teachers clothe themselves with the panoply of great national societies for the promotion of industrial education, and assemble once a year to discuss the feasibility and wisdom of industrial training, we direct attention to the one hundred and twenty-five young men in our factories who are actually getting an engineering education under commercial conditions.

Your committee on industrial education has erected a monument to this great cause that will rise in splendor and majesty as time endures, and we believe that at no distant date you will recall with pleasure and satisfaction that you were members of and contributors to an association which did so much to assist in revolutionizing industrial education.

National Gas and Gasolene Engine Trades Association

An association bearing the above title was organized in Chicago December 9, its object being announced to be "to promote, further, and advance the interests of the trade, also to hold a national convention once a year of the interested parties, the purpose of such convention to be for the promoting of education and sociability among the members of the association."

About 60 persons were present at the organization meeting. Harry T. Wilson, of Middletown, Ohio, was elected president, and Sebert Stritmatter, of Cincinnati, secretary. The next meeting will be held in Chicago the first Tuesday of February. All persons interested in stationary, automobile, or marine gas and gasolene engines are eligible to membership.

Manufactures exported from the United States in the fiscal year 1908 aggregated three-quarters of a billion dollars, a larger total than in any preceding year.

Business Items

The G. Drouve Company, of Bridgeport, Conn., has bought at a receiver's sale all machinery, material and fixtures of the American Machinery Company, 651 West 43d street, New York.

Trade Catalogs

W. H. Nicholson & Co., Wilkes-Barre, Penn. Pamphlet illustrating and describing inserted blade gas pipe taps.

The Hill Clutch Company, Cleveland, Ohio. Catalog G, describing friction clutches. Illustrated, 24 pages, 6x9 inches, paper.

Pratt & Whitney Co., Hartford, Conn. Catalog of milling machines, die sinkers and profilers. Illustrated, 40 pages, 9x12 inches, paper.

Breeze Carbureter Company, Newark, N. J. Pamphlet entitled "Carbureters and Engine Troubles." Illustrated, 36 pages, 3¼x6 inches.

United Engineering and Foundry Company, Pittsburg, Penn. Catalog of rolling mill machinery. Illustrated, 398 pages, 8½x10 inches, paper.

National Brake and Electric Company, Milwaukee, Wis. Publication No. 386, describing air compressors. Illustrated, 24 pages, 6x9 inches.

Westinghouse Electric and Manufacturing Company, Pittsburg, Penn. Calendar and diary for 1909. Illustrated, 96 pages, 2½x5½ inches, leather.

Jas. Clark, Jr. Electric Company, Louisville, Ky. Catalog of Willey electrically driven tools, dynamos and motors. Illustrated, 32 pages, 6x9 inches, paper.

Standard Roller Bearing Company, Philadelphia, Penn. Catalog No. 24 describing ball and roller bearings. Illustrated, 188 pages, 5x8 inches, paper.

Yale & Towne Mfg. Co., 9 Murray street, New York. Catalog of chain blocks, electric hoists, trolleys and cranes. Illustrated, 70 pages, 6x9 inches, paper.

Waltham Machine Works, Waltham, Mass. Catalog of bench lathes, automatic pinion and gear cutting machines, etc. Illustrated, 22 pages, 6x9 inches, paper.

Nutter & Barnes Co., Boston, Mass. Catalog No. 14, describing metal saw cutting off machines and automatic saw sharpeners. Illustrated, 20 pages, 6x9 inches, paper.

Manning, Maxwell & Moore, Inc., 85 Liberty street, New York. General catalog showing complete line of machine tools for which this company is distributor. Handsomely bound in cloth, 10x12 inches, illustrated, 1174 pages.

Business Opportunities

The Buffalo (N. Y.) Metal Furniture Company will erect a new factory.

The Oregon Chair Company, Portland, Ore., will erect an additional factory.

An addition will be built to the plant of the Detroit (Mich.) Range and Boiler Company.

Apperson Bros., Kokomo, Ind., builders of motor cars, will erect a three-story addition.

The tannery of T. F. Boyle & Co., at Milford, N. H., was burned, causing a loss of $175,000.

The American Linen Company, Fall River, Mass., proposes to build a $200,000 addition.

The Turnerized Metal and Canvas Roofing Company, Bessemer, Ala., will erect a new plant.

The plant of the Indiana Box Company, Muskegon, Mich., was destroyed by fire. Loss, $30,000.

The Cascade Foundry Company, Erie, Penn., is having plans prepared for an addition to foundry.

The St. Louis (Mo.) Smelting and Refining Company will build a $500,000 plant at Collinsville, Ill.

The Pioneer Auto Top Manufacturing Company, Kansas City, Mo., will erect a new two-story factory.

The Gerlach-Barklow Company, Joliet, Ill., manufacturing calendars, will erect two three-story additions.

The plant of the Cedarburg (Wis.) Foundry Company was destroyed by fire. It is said it will be rebuilt.

The Brighton Car Company of Chicago is negotiating for site in Minneapolis on which to erect a new plant.

The plant of the Florence Pump and Lumber Company, at Mobile, Ala., was destroyed by fire. Loss $80,000.

The box-making plant of the Atwood-McManus Company, Chelsea, Mass., recently destroyed by fire, will be rebuilt.

The United States Envelope Company, Springfield, Mass., is ready to begin construction of its new plant.

The Success Manufacturing Company, Gloucester, Mass., making refrigerators, etc., will double capacity of plant.

The Allegheny Steel Company will install two new 75-ton open-hearth furnaces at its plant in Tarentum, Penn.

It is reported that the Yadkin Knitting Mills, Lexington, N. C., destroyed by fire some time ago, will shortly be rebuilt.

The car erecting shops of Rhodes, Curry & Co., at Amherst, Nova Scotia, were destroyed by fire. Loss, about $150,000.

Fire destroyed the pattern shop of the Mesta Machine Company at West Homestead, Penn., causing a loss of over $40,000.

The Pittsburg (Penn.) White Metal Company has increased its capital and will erect a large plant in the Pittsburg district.

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Draftsmen—Fit your drawing table with a parallel device, $2.50. F. G. Hobart, Beloit, Wis.

Light fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Machines designed; automatic, special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Will accept good patent right, in part payment for real estate. Give particulars and price. Box 121, Cincinnati, Ohio.

Wanted—6 or 8-foot boring and turning mill, second-hand, must be in good condition. State price. Box 763, AMERICAN MACHINIST.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Wanted—Articles to manufacture by contract or will buy patent, tools and fixtures outright, by a manufacturer having a large and well equipped plant and capital. Address Box 564, Erie, Penn.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Agencies wanted for Germany, for machine tools, any kind of machinery, labor-saving tools, etc., by mechanical engineer. Send letters to P. O. Box 116, Sheboygan Falls, Wis., and I will call on you.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Superintendent who can make profits wants change. Box 773, AMERICAN MACHINIST.

Chief draftsman or assistant engineer, 20 years' experience, 10 years in charge. Heavy machinery, factory layouts, steam plants and factory buildings. Technical graduate. Box 769, AMERICAN MACHINIST.

ILLINOIS

Tool room foreman desires change; first class on tools for adding machines, cash registers and typewriters. Box 764, AMER. MACH.

Mechanical draftsman, eight years' experience on jigs, dies and special tools for typewriter, adding machine and light interchangeable work. Box 755, AMERICAN MACHINIST.

MASSACHUSETTS

Position wanted by foreman blacksmith; capable, reliable, up-to-date; handles men successfully. Address "Foreman," AM. MACH.

I wish to correspond with any company desiring the services of a progressive and up-to-date manufacturing superintendent. Box 701, AMERICAN MACHINIST.

MICHIGAN

Responsible situation wanted by party at present engaged as chief draftsman on tools with large automobile concern. Age 32, college graduate, with considerable shop and drafting room experience. A-1 designer of special and automatic machinery, mill design, structural work and salesmanship. Address "E. K.," 128 Farmer St., Detroit, Mich.

NEW JERSEY

Tool room foreman; any number of men, all branches, all grades. Highest efficiency; best references. "Ability," AMERICAN MACHINIST.

NEW YORK

As inspector with broad experience on machine tool work. Box 774, AMER. MACH.

As superintendent by first class mechanic after first of January. Best of references. Box 710, AMERICAN MACHINIST.

Expert tool designer, desires change. Ten years' experience on tools, jigs and fixtures. Box 767, AMERICAN MACHINIST.

Draftsman, five years' experience, technical graduate, wants position near New York City. Box 772, AMERICAN MACHINIST.

Mechanical draftsman, 26 years old, expert in pumping machinery, wants a position. Expects a salary of $18 weekly. Box 754, AMERICAN MACHINIST.

Superintendent or general foreman, 25 years' practical experience. Prefer large or medium work. Capable, energetic and familiar with use of high speed steel. Thoroughly versed in engine work. Box 726, AMERICAN MACH.

High-grade designer; inventive ability, technical, resourceful; five years' machine shop experience, seven years designing original light automatic machinery, heavy machine tools, hydraulics, electrical machinery; very able. "Successful," AMER. MACHINIST.

PENNSYLVANIA

Position wanted by a tool department foreman; a high-class man. Box 746, AM. MACH.

Mechanical, structural draftsman, 27, technical graduate, five years' practical experience, wants work. Box 738, AMER. MACH.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—A first class mechanical draftsman, one familiar with elevator construction preferred. Give references, experience and salary expected. Box 760, AMERICAN MACH.

ILLINOIS

Wanted—Machinery supply salesman to handle a crackerjack machinery specialty, either on salary, commission or as side line. Give particulars in first letter. Box 758, AM. MA.

Wanted—Superintendent of machine shop, capable of checking detail drawings, designing tools, modern shop practice, with experience in building bottling machinery. State education, experience and salary wanted. Apply to Goetz & Floden Mfg. Co., 109-133 W. Chicago Ave., Chicago, Ill.

Wanted—Tool and die maker for small parts. Must have at least 15 years' practical experience, be steady and possess tact and ability in handling about 12 men and turning work out quickly and economically. Address, giving full particulars, age and lowest wages to commence. Box 770, AMERICAN MACH.

Wanted—Chief draftsman of proved designing and executive ability, as well as energy and brains, to distribute and accurately supervise work, check up drawings and systematize records and methods in designing department of Chicago factory employing from 300 to 500 men in the manufacture of special automatic machinery. Excellent opportunities will be offered to high grade man. State fully qualifications and previous experience along these lines, with references. Box 733, AMER. MACH.

INDIANA

Wanted—Two inspectors, two grinders, six lathe men, two toolmakers, one foreman, four machinists, all for work on gasolene motors. Good wages. Box 666, AMERICAN MACHINIST.

MASSACHUSETTS

Wanted, by large manufacturing company, a good mechanical draftsman; one with actual machine shop experience preferred. State experience, age and salary wanted. Box 765, AMERICAN MACHINIST.

Wanted—Two pump draftsmen with wide experience on direct-acting and flywheel pumping engines and air compressors; those with technical education preferred. Address "Pump," Box 776, AMERICAN MACHINIST.

Wanted, by a large manufacturing company, competent mechanical draftsman experienced in steam turbine design; technical graduate preferred and knowledge of Riedler-Stumpf type turbine highly desirable. State age, experience and salary desired. Box 766, AM. MA.

MICHIGAN

Wanted—A number of operators on Jones & Lamson, Potter & Johnston and National Acme machines, both day and night work. Must be men of first-class experience. Cadillac Motor Car Company, Detroit, Michigan.

NEW JERSEY

Help Wanted, Male—Wanted, operator for Cleveland and Gridley screw machines. Good position to right man. Box 756, AMER. MACH.

Wanted—Operator on Landis plain grinding machines, who could act as assistant foreman. Splendid opportunity for right man. Box 757, AMERICAN MACHINIST.

NEW YORK

Wanted—A draftsman and designer, experienced in watch factory practice, designing and building watch and clock movements and tools for manufacturing same. Only man of experience wanted. "X. Z.," Box 741, AMERICAN MACHINIST.

Wanted—A mechanical man capable of finding and describing in a popular way, but correct mechanically, for laymen, the interesting and new inventions, machines, etc., that are being built and introduced into every line of human endeavor. Permanent and remunerative place for a live one. Box 771, AMERICAN MACHINIST.

Designer Wanted—First-class man on gas or steam engines in the medium powers. Practical man with shop or operating experience, capable of developing new ideas on drafting board. Permanent position with large New York City firm to the right party. State detailed experience, age and salary. Address "Large Firm," Box 775, AM. MACH.

OHIO

Wanted—Superintendent for tool shop manufacturing 14" lathes, to take my place as superintendent on stock. A good chance for one with a little capital. Box 759, care AMER. MA.

PENNSYLVANIA

Wanted—Five first-class tool and die makers, who are competent to lay out and machine accurately and rapidly a large variety of intricate interchangeable parts. Applicants must be competent to read and work to blueprints. Preferably men who have had several years' experience in typewriter and cash register work desired. Box 761, AMERICAN MACHINIST.

Foreman painter wanted by a concern manufacturing high grade automobiles to take full charge of chassis and body work, a man who is capable of organizing the shop to turn out

25 to 30 cars per week. Only persons who have been connected with best automobile concerns, fully capable of handling this class of work, will be considered. Best of references required. State salary expected. Box 734, AMERICAN MACHINIST.

WISCONSIN

Shop superintendent wanted in the manufacture of lubricating specialties. Must have ability to get up new designs. State experience and salary expected. Box 762, AM. MA.

Wanted—First class mechanic, to take charge of tool check room of electrical manufacturing company in Middle West. Elderly man preferred. In applying state age, experience and wages wanted. Box 742, AMER. MACH.

For Sale

Garvin No. 3 hand-feed milling machine. I. F. Wales, Keene, N. H.

For Sale—One second-hand Wheeler planer, 22x5 ft., $125. S. M. Langston, Camden, N. J.

Two and fifteen-sixteenths inch cold rolled steel shafting. We will cut to any desired length up to 4′ 6″. Ask for prices. Box 768, AMERICAN MACHINIST.

For Sale, absolutely new, a No. 2½ heading machine and a No. 2½ reheading machine, Waterbury-Farrel make, never used. Ohlen Company, Box 740, Columbus, Ohio.

For Sale—Drawings, patterns, tools and good will of a well known marine reverse gear business. Best of reasons for selling. A splendid opportunity for anyone in machine business to acquire first-class specialty. Particulars to responsible parties. Address "D. R.," AMERICAN MACHINIST.

For Sale—A solid brick, steel construction, factory building, with 7½ acres of land near Chicago. Now unoccupied. Size 110x541. Suitable for iron working business. Has engine, boilers, dynamos, etc. Most favorable prices and terms will be given. Chicago Highlands Association, 1315 Wells Building, Milwaukee, Wis.

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Rahway Valley R. R.	96
Reed Co., F. E.	47
Reed Mfg. Co.	61
Reeves Pulley Co.	85
Reichhelm & Co., E. P.	74
Reynolds Machine Co.	77
Rivett Lathe Mfg. Co.	3d cover
Rockford Drilling Machine Co.	65
Rockwell Furnace Co.	85
Rockwood Mfg. Co.	83
Rogers & Hubbard Co.	87
Rogers Wks., John M.	72
Root Co., C. J.	77
Roth Bros. & Co.	89
Safety Emery Wheel Co.	60
Sanford Mfg. Co., F. C.	87
Saunders Sons, D.	72
Sawyer Gear Works	78
Schieren Co., Chas. A.	74
Schuchardt & Schutte	74
Schumacher & Boye	9
Screw Machine Products Corp.	75
Sebastian Lathe Co.	25
Sellers & Co., Inc., Wm.	30
Seneca Falls Mfg. Co.	68
Shelby (National) Tube Co.	87
Shepard Electric Crane and Hoist Co.	82
Shultz Belting Co.	76
Sibley Mch. Tool Co.	71
Skinner Chuck Co.	80
Slate Machine Co., Dwight	73
Sloan & Chace Mfg. Co., Ltd.	49
Slocomb Co., J. T.	73
Smith Countershaft Co.	68
Smith & Mills	92
Smith Co., Wm. J.	59
Spacke Mach. Co., F. W.	91
Springfield Mach. Tool Co.	15
Standard Connecting Rod Co.	98
Standard Engineering Works.	76
Standard Gauge Steel Co.	98
Standard Tool Co.	68
Standard Welding Co.	58
Stark Tool Co.	92
Starrett Co., L. S.	45
Stoever Fdry. & Mfg. Co.	77
Straley & Hasbrouck	91
Sturtevant Co., B. F.	16
Tabor Mfg. Co.	72
Taylor & Fenn Co.	67
Taylor-Wilson Mfg. Co.	78
Toomey, Frank	96
Triumph Electric Co.	89
Trump Bros. Machine Co.	80
Tudor Mfg. Co.	90
Underwood & Co., H. B.	77
Union Mfg. Co.	80
Union Twist Drill Co.	51
Universal Fluxine Co.	86
Universal Machine Screw Co.	66
U. S. Electrical Tool Co.	89
Van Dorn & Dutton Co.	79
Van Dorn Elec. & Mfg. Co.	89
Vandyck Churchill Co.	64
Vitrified Wheel Co.	60
Von Wyck Mach. Tool Co.	90
Walcott & Wood Mach. Tool Co.	76
Waltham Watch Tool Co.	76
Walton Co., The	86
Ward & Sons, Edgar T.	85
Warner & Swasey Co.	31
Warner Instrument Co.	72
Waterbury Farrel Fdry. & Mach. Co.	74
Watson-Stillman Co.	65
Western Electric Co.	88
West Haven Mfg. Co.	90
Westmacott Gas Furnace Co.	86
Whitcomb-Blaisdell Machine Tool Co.	19
Whitman & Barnes Mfg. Co.	63
Whitney Mfg. Co.	43
Whiton Machine Co., D. E.	80
Wiley & Russell Mfg. Co.	73
Williams & Co., J. H.	66
Wilmarth & Morman Co.	61
Windsor Machine Co.	26
Woburn Gear Works	79
Woodward & Powell Planer Co.	73
Worcester Machine Screw Co.	77
Wormer Machinery Co., C. C.	96
Yale & Towne Mfg. Co.	82